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# DISSERTATION ABSTRACTS

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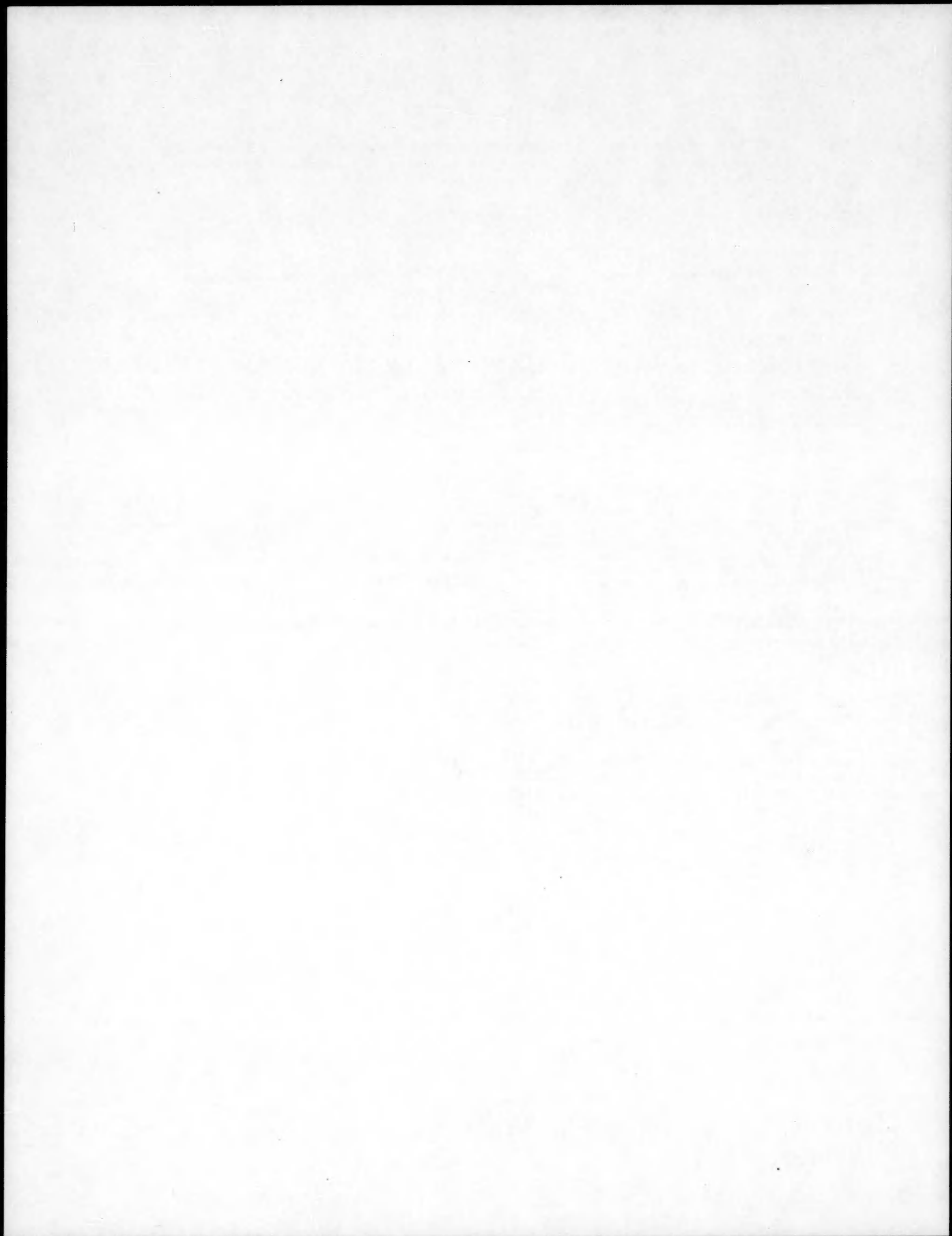
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## AGRICULTURE

### AGRICULTURE, GENERAL

#### A THEORY OF ION EXCHANGE BEHAVIOR IN IRON OXIDE-KAOLINITE SYSTEMS

(L. C. Card No. Mic 60-3717)

William Albert Berg, Ph.D.  
North Carolina State College, 1960

Supervisor: Nathaniel Terry Coleman

Iron oxide-kaolinite-complexes, synthesized by the hydrolysis of  $\text{FeCl}_3$  in the presence of kaolinite, gave ion exchange characteristics similar to those of kaolinitic soils containing substantial amounts of iron oxides. Ion exchange behavior common to both systems included: anion adsorption, conductometrically titratable but nonexchangeable Al, blocking of cation exchange capacity (CEC) by the iron oxides, and relatively large amounts of pH-dependent CEC.

A theory to explain the above behavior was proposed. The theory suggests that an electrostatic interaction exists between positively charged iron oxides and negatively charged kaolinite, the iron oxide essentially acting as a cation and being attracted to cation exchange sites on the kaolinite. Thus a portion of the CEC on the kaolinite appears to be blocked. Anions can be adsorbed on the iron oxide by interacting with the positive charge. In this way the interaction between the iron oxide and kaolinite may be reduced and negative exchange sites on the clay again become available for cation adsorption.

Likewise, conductometrically titratable but nonexchangeable Al is explained by the theory, for upon addition of a base to an iron oxide-kaolinite system the hydroxyls react to reduce the positive charge on the iron oxides. This reduces the iron oxide-kaolinite interaction and the cations of the base can be adsorbed by the negative sites freed on the clay. Thus the conductivity of the system upon addition of base would not increase as rapidly as expected and, therefore, would give a conductometric titration quite similar to that of exchangeable Al. A portion of the pH-dependent CEC in iron oxide-kaolinite systems can, therefore, be explained as due to increased cation adsorption caused by freeing of negative sites on the clay.

Experiments carried out suggest that the positive charge on iron oxides is due to hydroxyl dissociation. Evidence leading to the conclusion includes: 1) Increased anion adsorption as the pH is decreased or the concentration of anions in the equilibrium solution is increased, 2) An increase in pH upon addition of neutral salt to an iron oxide-cellulose powder-complex suspended in water, 3) Equivalent amounts of base added to systems of iron oxide sol suspended in water or in salt solutions resulted in a higher pH in the salt solutions over the pH range of 4 to 9.

Electron micrographs revealed that iron oxide, formed by the hydrolysis of  $\text{FeCl}_3$ , was deposited as small particles

on the surfaces of kaolinite. Electron micrographs of clay separated from a Cecil soil revealed a somewhat similar picture. However, in neither case could the presence of a crystalline iron oxide be determined by electron diffraction techniques.

Microfilm \$2.50; Xerox \$4.60. 88 pages.

#### PHOSPHATE STUDIES IN FLOODED SOILS

(L. C. Card No. Mic 60-3720)

Jorge Gelbolingo Davide, Ph.D.  
North Carolina State College, 1960

Supervisor: Nathaniel Terry Coleman

Rice plant responses, in terms of the extent of tillering, dry matter yield and total phosphorus uptake were dependent on the source of phosphorus and were modified greatly by flooding. In addition, there were flooding x source interactions. With monocalcium phosphate as the source, responses were almost the same in the flooded and nonflooded soil. Aluminum phosphate produced better growth and appeared to be more available in the nonflooded conditions. Iron phosphate, particularly in the White Store soil, gave much better response, even comparable to monocalcium phosphate, in the flooded situation. The beneficial effect of flooding on phosphate availability depends on the extent of reduction processes and the iron content of the soil.

Larger A-values were obtained with monocalcium phosphate compared to other sources. Flooding somewhat decreased the A-value with monocalcium phosphate as the source, had little effect with the aluminum phosphate, but resulted in a large increase with the iron phosphate.

In a medium consisting of sand-cation-exchange resin-nutrient solution, which would not interact directly with the phosphorus sources and which did not contain native phosphate, tillering, dry matter and phosphorus yields of rice were increased by flooding. The availabilities of calcium, aluminum, and iron phosphates as measured by the A-value also were increased by flooding.

The solubilities of calcium, aluminum and iron phosphates, measured by  $\text{HCl-H}_2\text{SO}_4$  extraction on soils which were incubated under flooded and nonflooded conditions, were greater when the soils were flooded. The amount of phosphorus extracted decreased with time. With longer period of incubation the magnitudes depended more on the kind of soil rather than on the phosphorus source, being considerably smaller for the Cecil than for the White Store. With the Dunbar and Bladen soils, monocalcium phosphate stayed quite soluble with time and iron phosphate was more soluble than aluminum phosphate in the flooded conditions. The greater solubility of phosphate, particularly from the ferric form, was attributed to

reduction of iron. However, only relatively small proportions of the free iron oxide content of the soil were reduced. The small quantities of phosphorus extracted after longer periods of incubation may have been due to re-fixation of any phosphate solubilized by the reduction process. Drying lowered the solubility of phosphorus and iron, suggesting that from the standpoint of soil testing, flooded soils should never be allowed to dry.

When soils were shaken with  $P^{32}$ -labeled phosphate, there was an exceedingly rapid loss of  $P^{32}$  from solution, especially when the soils were flooded. Part of the  $P^{32}$  sorbed by the soil was desorbed on treatment with various chemical extracting reagents. The low recovery of radioactivity from the flooded soils by these reagents was attributed to the activation of more adsorptive sites on flooding.

The rates of uptake and recovery of  $P^{32}$  and  $P^{31}$  by anion-exchange resin (IRA-400, OH) were low in the flooded soils. Under the conditions of the experiment where continuous shaking was employed, the iron compounds must have changed state in the direction of increasing adsorptive capacity of the flooded soil, thus reducing the rate and amount of phosphorus released to the resin.

Microfilm \$2.50; Xerox \$8.20. 180 pages.

#### DIFFUSION IN CLAY-WATER SYSTEMS

(L. C. Card No. Mic 60-4163)

Gordon Richard Dutt, Ph.D.  
Purdue University, 1960

Major Professor: Philip F. Low

The amounts of LiCl and NaCl diffusing in the steady-state through Li- and Na-clay pastes and the salt distribution within these pastes were determined. From these data, the diffusion coefficients were calculated for different segments of the pastes. It was found that these coefficients were dependent on salt concentration. An algebraic summation, using the diffusion coefficients for different segments of the path, was employed to obtain an apparent diffusion coefficient within the paste. The apparent diffusion coefficients had the values  $3.52 \times 10^{-6}$  cm.<sup>2</sup> per sec. and  $3.20 \times 10^{-6}$  cm.<sup>2</sup> per sec. for LiCl and NaCl, respectively. The order of diffusion coefficients was the same as was found, using Fick's first law, for  $D_2O$  diffusion across different samples of the same clays.

Concurrently, in the same systems, the apparent diffusion coefficients across the clay pastes, i.e., solution--paste--solution, were found. These diffusion coefficients were obtained using Fick's first law and assuming that the diffusion coefficient was independent of concentration. The apparent diffusion coefficients found by this method were  $1.39 \times 10^{-6}$  cm.<sup>2</sup> per sec. for LiCl and  $2.10 \times 10^{-6}$  cm.<sup>2</sup> per sec. for NaCl. The apparent diffusion coefficients, reported in the previous paragraph were in a different order and had a larger magnitude than those reported in this paragraph. Since the former did not include the diffusion coefficients for diffusion across the interfaces while the latter did, the diffusion coefficients across the interfaces must have been small. Because the order of diffusion coefficients for  $D_2O$  diffusion across the pastes was the

same as that for salt diffusion within the pastes it was concluded that the low diffusion coefficients at the interfaces were due to electrical interaction between the negatively charged clay and the ions of the salt at these interfaces.

The diffusion coefficients for the diffusion of  $D_2O$  across the different pastes were determined at different temperatures. Therefore, it was possible to calculate the activation energies for diffusion. The activation energies were 4.9 k. cal. for the Li-clay system and 4.0 k. cal. for the Na- and K-clay system. Since the activation energy for diffusion of  $D_2O$  in normal water is 4.6 k. cal., it was postulated that the water structure in the Li-clay was more coherent than normal water and that the water structures in the Na- and K-clays were less coherent than normal water. It was also postulated that these differences in activation energies may have been due to a difference in the mechanism of  $D_2O$  diffusion in the clay pastes.

A direct current method was used to measure the specific conductances and apparent mobilities of the adsorbed cations on Li-, Na- and K-clays. The specific conductances and apparent mobilities were found at different temperatures and times. This procedure permitted the calculation of the activation energies for movement of the adsorbed cations at different times. With the same apparatus it was also possible to measure the electro-osmotic movement of water. The data show that the specific conductances and apparent mobilities for the exchangeable cations on these clays were in the order  $Li > Na > K$ . The activation energies for the movement of the exchangeable cations were 4.6 k. cal. per mole for the Li-clay and 4.2 k. cal. per mole for Na- and K-clays. At a potential of 0.024 volts within the clay paste it was found that there was electro-osmotic movement of water only in the case of the Na-clay and that this movement was small. When the movement was stopped by closing a system of stopcocks, no significant change in conductance was observed. In the K-clay, movement did occur at the higher voltage of 0.093 volts. No movement of water occurred in the Li-clay at either voltage. It was concluded that the electro-osmotic flow of water did not contribute significantly to the conductance of the ions.

The order of activation energies for ion movement was the same as the order of activation energies for  $D_2O$  diffusion in the three homoionic pastes. The magnitudes of the two activation energies were within experimental error for the corresponding pastes. This agreement in the order and magnitude of the activation energies for the charged ions and neutral  $D_2O$  molecules was taken as evidence that the same mechanism obtained for the movement of ions and water and that this mechanism involved the formation of a hole in the surrounding water as a prerequisite to movement.

Microfilm \$2.50; Xerox \$5.00. 98 pages.



**RATE OF RELEASE OF NITROGEN AND  
PHOSPHORUS FROM UREA-FORMALDEHYDE  
PRODUCTS AND UREA-FORMALDEHYDE  
COATED PHOSPHATES**

(L. C. Card No. Mic 60-4238)

Dale Robert Hensel, Ph.D.  
Rutgers University, 1960

Major Professor: Dr. E. R. Purvis

Excessive amounts of fertilizer phosphorus are normally applied to crops to compensate for phosphorus fixation by the soil. A product which would reduce phosphorus fixation, or retard the rate of phosphorus release from the fertilizer granule, would therefore have considerable economic value. The possibility of using resin coated products was considered and several urea-formaldehyde materials and coated fertilizer products were made available by the Allied Chemical Company. This investigation established the effects of the coatings on the rates of phosphorus release and on plant response.

In order to establish the rate of phosphorus release from the urea-formaldehyde coated and uncoated products, the products were leached with distilled water and successive increments of the leachate were analysed for phosphorus contents. The results established that the uncoated fertilizers released more phosphorus during the early stages of leaching. However, the amount of phosphorus released during the later stages from urea-formaldehyde coated fertilizers was significantly greater than the amount released by the uncoated products.

The respective rates of release from the coated and uncoated superphosphates were found to be a logarithmic function. The log of the phosphorus concentration of the leachate decreased with increasing time. The correlation coefficients for the relationship between log of the phosphorus concentration and leaching time was -0.996 and -0.991 for the coated and uncoated superphosphates respectively. The slopes of the two regression lines were significantly different and the total amount of phosphorus released from the urea-formaldehyde coated superphosphate in the later stages of leaching was significantly greater than the amount of phosphorus released from the uncoated superphosphate. A practical benefit might result if the coated phosphates or fertilizers were used on soils with high phosphorus fixing capacities.

Soils which had high phosphorus fixing capacities were fertilized with urea-formaldehyde coated phosphates in the greenhouse. Yields of sudan grass fertilized with the coated phosphates were significantly greater than the yields from the uncoated phosphates. The tops of the plants grown on the coated phosphate treatments showed significantly greater phosphorus uptake than the uncoated treatments.

No response to the coated fertilizers were noted under field conditions. Although the field soils used in these experiments tested very low in available phosphorus and had high phosphorus fixing capacities, they failed to produce a response to phosphorus fertilizers. This was attributed to the presence of large amounts of organic phosphorus in the soils.

Nitrification rates of four urea-formaldehyde products were established. The urea-formaldehyde compounds reacted differently on the two soils which were used in the experiment. Only one product showed the desired slow rate of nitrogen release.

To evaluate urea-formaldehyde compounds as nitrogen fertilizers, field trials were conducted with corn. Nitrogen was applied in the urea-formaldehyde form at the rate of 50 pounds per acre. No toxic effects were noted due to urea-formaldehyde. The corn yields from the urea and the urea-formaldehyde treatments were compared and showed no significant differences.

Microfilm \$2.50; Xerox \$6.00. 125 pages.

**DETERMINATION OF POTENTIALLY  
AVAILABLE NITROGEN IN SOIL  
BY ACID HYDROLYSIS**

(L. C. Card No. Mic 60-4240)

Micah Wei-Ming Leo, Ph.D.  
Rutgers University, 1960

Major Professor: Earnest R. Purvis

A reliable, rapid, chemical method for the determination of potentially available nitrogen in soils has been needed since the beginning of modern agricultural chemistry. Many attempts have been made to develop such a method but with little success.

According to accepted theory, soil nitrogen is composed largely of proteins. Microorganisms attack these proteins and by enzymatic hydrolysis release available nitrogen to crops. Based on the assumption that the organic nitrogen fraction of soils most readily available to plants is the first nitrogen released by hydrolysis, a procedure for determining the ammonia released by mild hydrolysis in  $H_2SO_4$  has been developed.

This method has been evaluated in greenhouse and field calibration studies. Three years' data from greenhouse trials on seven representative New Jersey soil types with Pennoll wheat have shown highly significant correlations between the potentially available nitrogen test and yield ( $r = 0.978^{++}$ ). The correlation between the results of the new method and nitrogen uptake of wheat was also significant at the 1% level ( $r = 0.976$ ). In comparison with nitrification tests in the laboratory, the newly developed method is faster, simpler in operation, and more closely correlated with crop response. It is concluded, after two years of field experiments with field corn, that the new rapid test is very promising. Reports from some Northeastern States participating in the regional project on nitrogen have supported the validity of the method. A final conclusion as to the value of the test can not be drawn until more extensive calibration tests have been conducted with different soils under various climatic conditions.

Microfilm \$2.50; Xerox \$5.80. 117 pages.



PROGRESSIVE CHANGES IN NATURAL AND  
LABORATORY POPULATIONS OF *CULEX*  
*PIPIENS* LINNAEUS (DIPTERA, CULICIDAE).

(L. C. Card No. Mic 60-4190)

Harlan Luther McMillan, Ph.D.  
Purdue University, 1960

Major Professor: Leland Chandler

The *Culex pipiens* complex in North America, north of Mexico, is made up of the typical subspecies, *C. p. pipiens* L., in the northern part of the range (generally north of 39° N. latitude) and *C. p. quinquefasciatus* Say in the southern part of the United States (generally south of 36° N. latitude). There is a poorly defined east-west zone across the central part of the United States, roughly between 36° and 39° N. latitude, in which the population is considered to be morphologically intermediate between the two subspecies. Other members of the *Culex pipiens* complex occurring in the United States are: *C. p. issip. molestus* which occurs mainly in the southern part of the range of the northern subspecies and *C. p. issip. pallens* (a form introduced from the Orient) which occurs in California. It is suggested that the name *C. p. issip. pallens* should be restricted to that North American population of Oriental origin and that it should not be applied to that intermediate population which occurs transcontinentally in the United States.

This study was concerned with a population of *C. p. pipiens* occurring in the vicinity of West Lafayette, Indiana. The diagnostic characters used to define this population were: the genitalia of the adult males as expressed in terms of the DV/D ratio; and, the number of branches in the siphonal tufts and pentad hairs one, three and five, and the number of pecten teeth on the siphon of the fourth instar larvae.

The field population of *C. pipiens* was sampled at intervals during the breeding seasons of 1958 and 1959. Individual egg rafts and mixed series of larvae were collected. Morphometric data obtained from these materials were analyzed to define the structure of the field population. Laboratory colonies were established in 1957 and 1958 with mosquitoes from this field population. The 1957 colony was maintained from October 1957 to October 1959. The 1958 colony was maintained from August 1958 to March 1959. Fourth instar larvae and adult males were removed for each generation of mosquitoes of the colonies to provide data for comparison with data of the field population. Thus, the nature of changes could be quantitatively expressed and the direction of the changes noted.

The mean values of the DV/D ratios of the males of the field population were within the range (less than 0.20) of *C. p. pipiens*. These values did not increase as the breeding seasons progressed in either 1958 or 1959. Likewise, neither did the larval characters show progressive change under field conditions. However, the mean values of the DV/D ratios of the males in the laboratory colony established in 1957 from the field population progressively increased and fell within the range (about 0.20 to 0.40) of an intermediate population. This progressive change indicated that the potential for variation was present in the population.

Tests for correlation were made between the various larval characters and the DV/D ratio of the males. In the laboratory colony, the correlation coefficients were significant for all sets of characters except for the mean number

of branches in siphonal tuft four and the mean number of branches in pentad hair three. In the field population this latter set of characters was the only set which showed a significant correlation.

Discussion is presented which suggests that, historically, *C. pipiens* and *C. quinquefasciatus* were species reproductively isolated by geographic separation. However, as a result of reciprocal introductions, the barrier to reproductive isolation was removed and hybridization and introgressive hybridization occurred throughout the area of range overlap. It would appear appropriate to consider the recency of this merger and to recognize the two forms as semispecies until a more definite pattern is indicated.

Microfilm \$2.50; Xerox \$6.00. 121 pages.

RESIDUAL PHOSPHATE STUDIES ON A  
PIEDMONT RED LOAM

(L. C. Card No. Mic 60-3730)

James Edward Shelton, Ph.D.  
North Carolina State College, 1960

Supervisor: Nathaniel Terry Coleman

Conventional methods of phosphate fertilization in many areas of the Southeastern United States have resulted in a great excess of phosphate added over that which is taken up by the harvested plants. Presumably this is due to "phosphate fixation" and resulting poorer yields when phosphate is not added. The objective of the work presented in this thesis was to determine if the phosphate fertility status of a red loam Piedmont North Carolina soil of high "phosphate fixing" capacity could be built to high levels of phosphate fertility through heavy initial application of phosphate fertilizer, and if an established high level could be maintained.

Field experiments conducted on a Georgeville silt loam and extending over a period of three years showed that the "available phosphorus" level of the soil could be raised from low to high by initial heavy fertilization with mono-calcium phosphate. The residual effects obtained from initial applications of  $P_2O_5$  ranging from 350 to 2800 pounds per acre depended on the rate of fertilization, the time elapsed since fertilizer application, and whether or not annual maintenance phosphate fertilization was practiced.

Initial application rates of 350 pounds of  $P_2O_5$  per acre maintained near maximum growth of wheat for the first two years but yields dropped the third year if maintenance applications of phosphate fertilizer were not made where the initial application was 700 pounds of  $P_2O_5$  per acre or larger, maximum growth has resulted over the three year period, and there has been no response to maintenance application.

Soil test phosphate levels on plots receiving 700 pounds of  $P_2O_5$  per acre or less as an initial application have shown a continual decrease, and plots receiving 350 pounds are now only slightly higher than the check plots. If this downward trend in soil test phosphate continues at the present rate then responses to phosphate fertilization are expected on the 700 pounds  $P_2O_5$  per acre initial application plots in the next two or three years.

Fractionation of field and laboratory phosphated soils indicated that much of the applied phosphate existed in the soil in the form of iron or aluminum phosphate compounds. In the early stages of fixation somewhat larger portions of the applied phosphate were to be found in the aluminum phosphate form, but fractionation into iron and aluminum phosphates showed a decrease in aluminum phosphate with time and a corresponding increase in iron phosphate. This conversion of the more soluble aluminum compounds into the less soluble iron compounds may account for some of the decrease in soil test phosphate and in the plant yields with time.

Isotope dilution ("A" value) experiments also indicated that a large portion of the applied phosphate was initially available, but that the amount decreased with time.

Isotope dilution experiments with  $P^{32}$ -labelled synthetic iron and aluminum phosphates, with molar ratios of R:P from 1 to 100, showed that the plant availability of the phosphorus in such substances depended on the R:P ratio. For relatively narrow-ratio materials, aluminum phosphates were more available than iron phosphates. Consequently it was concluded that the reduction in phosphate availability with time which was observed for the field soils could be accounted for not only by the conversion of the aluminum phosphates to iron phosphates but also in part by the slow development of substances in the soil analogous to the wide-ratio synthetic materials.

Microfilm \$2.50; Xerox \$5.80. 118 pages.

#### SOIL DEVELOPMENT ON THE RED BEDS OF NEW JERSEY

(L. C. Card No. Mic 60-4266)

Fiorenzo C. Ugolini, Ph.D.  
Rutgers University, 1960

Major Professor: J. C. F. Tedrow

The William L. Hutcheson Memorial Forest in New Jersey approximates the primeval type of forest in the eastern United States. Soils are formed primarily from underlying Brunswick shale of Triassic age and some fluvial deposits. Red shale soils display a rather unique morphology in that they have not acquired the podzolic characteristics as have other soils of the general area formed from other types of parent material.

Three profiles of the forest were studied in detail. Morphology is described, and particle size, permeability, pH, organic matter, organic carbon, nitrogen, fusion analysis of the total soil and clay, and cation exchange studies made. Emphasis was placed on distribution of light and heavy minerals, and clay mineralogy including X-ray diffraction, differential thermal analysis, and electron microscopy. A map showing the distribution of soil types is included.

Soil texture approximates a silty loam through most of the forest except in the western part where it approximates a loamy sand on the fluvial deposit. pH of the soils approximate 4.5-5.5 and organic matter is present in the A<sub>2</sub> horizon at the 4.2 percent level and decreases with depth. Other characteristics determined in the soil derived from the Triassic shale are cation exchange capacity expressed

in millequivalent per hundred grams of soil which is 8.7 at the surface and 8.9 in the C-D. The  $SiO_2/R_2O_3$  molar ratio of the total soil is 11.1 in the A<sub>2</sub>, 11.2 in the B and 3.3 in the bedrock. The clay has a  $SiO_2/R_2O_3$  molar ratio of 2.7 in the A<sub>2</sub>, 212 in the B, and 1.9 in the C-D. Light minerals consist mainly of quartz, mineral aggregates, and some feldspars. The heavy minerals consist of black opaque, other opaque, zircon, tourmaline, and others. There is evidence of some admixture of materials. Clays consist of a dioctahedral illite which has weathered to vermiculite at the surface under acid conditions. The soils formed under more coarse texture have chlorite as a product of weathering rather than vermiculite.

From interpretation of the collected data, it was found that the genesis of the red-shale soils is partially dictated by the bedrock, the characteristics of which tend to be maintained in the soil. In view of this conditions, an attempt was made to disclose the origin of the Triassic shale. It appears that the Brunswick formation originated under a humid subtropical type of climate. The paleoclimate existing during the Newark epoch helps to explain some of the features of the soils such as the red color, the immobility of the iron compounds and the resistance of the shale to weathering.

Another property present in the soils and related to the bedrock is the unusual high cation exchange capacity of the C horizon, which has been explained as being a function of the clay-impregnated shale fragment. This characteristic acquires special interest in the soil-plant relation. The acid weathering of this humid temperate region, while it had not been able to produce relevant chemical transformations of the Brunswick shale, had been very active in degrading the illite into a vermiculite. In addition, under the same influence, the more soluble iron has been removed from the surface and redeposited as coating in the lower horizons. The taxonomy of these soils has been considered and their appurtenance to the Gray Brown Podzols has been questioned because of the lack of decisive morphological and internal characteristics to conform them to this great soil group.

The braunerde of Ramann might possibly be a better group in which to place the red shale soils.

Microfilm \$2.50; Xerox \$6.20. 128 pages.

#### AGRICULTURE, ANIMAL CULTURE

##### RATE OF OVULATION AND IMPLANTATION IN SWINE AS AFFECTED BY DIETARY FACTORS

(L. C. Card No. Mic 60-3873)

Charles Roger Adams, Ph.D.  
University of Illinois, 1960

In an endeavor to determine the effect of various dietary regimens on reproductive performance in swine, breeding gilts were introduced to various dietary treatments.

Gilts that received a high caloric intake, both before and after breeding, exhibited a higher rate of ovulation and a greater number of embryos. The rate of gain was increased and the gain-feed ratio was improved with the



higher energy intake. It was noted that the period (before or after breeding) at which the energy intake was altered had a significant effect on total and anterior pituitary weight. The concentration of thyrotrophic and gonadotrophic hormones of the pituitaries from the gilts on a higher energy intake was greater. Embryo and placental membrane weights were not affected by treatment. It was observed that ovulation rate affected implantation rate in a negative direction.

Further experimentation with levels of protein and the feeding of a thyrotrophic substance, tri-iodothyronine, demonstrated that neither a twenty nor an eleven percent protein diet, with or without tri-iodothyronine, had any significant effect on ovulation or implantation rate. The data did suggest that 200 micrograms of tri-iodothyronine augmented implantation at both levels of protein. The gilts that received the twenty percent protein diet showed a greater rate of gain and an improved gain-feed ratio. Neither level of protein nor tri-iodothyronine had an effect on embryo or placental membrane weights. The corpora lutea index (weight in grams times diameter in millimeters of corpora lutea) was greater in gilts that received 200 micrograms of tri-iodothyronine than those that received 400 micrograms.

Experimentation with sources of protein and lysine supplementation for gilts, yielded information that a "protein-free" diet (chemical analysis showed 0.39% protein equivalent) would not support reproduction. Actually, only two of the animals in this lot showed a normal estrous cycle; of these only one conceived and revealed fifty percent of the ova as embryos at the twenty-fifth day of gestation. The weight of the anterior pituitary gland and the concentration of thyrotrophic and gonadotrophic hormones were less in the group that received the "protein-free" diet.

Ovulation rate was greatest in the groups receiving a thirty-two percent protein diet and a fifteen percent protein sesame meal diet with supplemental lysine; the number of embryos present was also greatest in these groups.

Treatment did not have any effect on embryo weights.

Gonadotrophic hormone concentration of the pituitaries was highest in the animals fed the thirty-two percent protein ration.

In that lysine supplementation of a corn-sesame diet had no effect on rate of gain, but did influence reproductive performance and hormone concentration of the anterior pituitary, one might conclude that the lysine requirement for reproductive processes is greater than for optimum growth.

Microfilm \$2.50; Xerox \$4.60. 87 pages.

#### SOME ASPECTS OF THE ROLE OF MUSCLE CREATINE IN GROWTH OF THE YOUNG PIG

(L. C. Card No. Mic 60-3878)

John Patton Baker, Ph.D.  
University of Illinois, 1960

Experiments were conducted to determine the pattern of muscle creatine level during early life of the pig. In the first experiment pigs were selected at random from normal litters to be sacrificed at birth, 1, 2, 3, 4, 6, 10, and 14 days of age. Samples of tissue were taken from the ham muscle for determination of creatine. The analyses re-

vealed that the level of muscle creatine increased a significant amount during the first fourteen days of life and that the major portion of this increase occurred after the sixth day. Results of this experiment were corroborated by those of another trial in which pigs were sacrificed at birth, 1, 3, 5, and 10 days of age. In this trial there was a significant increase in muscle creatine during the first ten days of life, the major portion of which occurred between five and ten days. In the latter trial treatments were imposed on the pigs, but the variation attributable to treatments was removed by statistical methods for the calculation of the effect of age. The treatments, given in an attempt to increase the level of muscle creatine at a faster rate and/or an earlier age, consisted of daily intraperitoneal injections of a creatinine solution and of a solution of arginine, glycine, and methionine and were given from birth until the time of sacrifice. The control treatment consisted of daily injections of a physiological saline solution. Neither of the treatments was effective in altering the level of muscle creatine.

Six growth experiments were conducted in which intraperitoneal injections of creatine and creatine precursors were administered to suckling pigs to study the effect of these compounds on growth of the pig. In two of these experiments a single dose of the compounds used was injected twelve to twenty-four hours after birth, while in the others daily low-level dosages were given. The compounds used in these studies included arginine, glycine, arginine plus glycine, arginine plus glycine plus methionine, guanidoacetic acid plus methionine, creatine hydrate, and creatinine. In one trial concomitant injections of testosterone propionate were given with the creatine precursors. In one of the trials in which a single injection was used, the material administered consisted of graded levels of creatine hydrate ranging from 0.25 gm. to 2.00 gm. of creatine. In a trial in which multiple daily injections were given, the materials administered were arginine plus glycine plus methionine, with the ratios varied to approximate those occurring in sow's milk and in sow's colostrum. In these experiments none of the treatments were effective in increasing growth rate of the suckling pig, and in some cases of high-level dosage a growth depression resulted.

A feeding trial was conducted in which graded levels of creatine hydrate were added to a fortified casein-lactose basal diet for early-weaned pigs. No consistent growth response was produced by these treatments.

It was concluded from these experiments that, although muscle creatine increases a significant amount during the second week of life but not during the first, the supply of creatine precursors does not limit the synthesis of creatine or growth in the very young pig.

Microfilm \$2.50; Xerox \$4.40. 83 pages.

#### PHOSPHORUS NUTRITION OF SWINE

(L. C. Card No. Mic 60-3904)

William Arliss Dudley, Ph.D.  
University of Illinois, 1960

An experiment was conducted to evaluate various sources of phosphorus for their ability to supplement a diet for gestating and lactating swine. The control diet was a

practical corn-soybean oil meal diet containing approximately 0.30% phosphorus and 0.80% calcium. Experiments, employing both a practical corn-soybean oil meal diet and a purified diet, were also conducted to determine the phosphorus requirement of the weanling pig. The corn-soybean oil meal diet contained approximately 0.34% phosphorus and 0.80% calcium. The purified control diet contained 0.1 to 0.2% phosphorus and 0.8% calcium. Employing the purified control diet, blood inorganic phosphorus, a mineral balance technique, femur ash, tail ash, average daily gain, average daily feed, and average gain/feed were evaluated as criteria for the measurement of phosphorus availability for the weanling pig. The following statements summarize the findings:

1. Gilts that have been raised on phosphorus adequate diets performed normally for at least two gestation-lactation periods when fed a corn-soybean oil meal diet without supplemental phosphorus. Therefore, the phosphorus requirement for gestation and lactation did not appear to be greater than 0.3% of the diet. None of the sources of supplemental phosphorus, including soft phosphate, caused an impairment in gilt performance.

2. A practical corn-soybean oil meal diet did not contain sufficient available phosphorus to promote maximum performance of the weanling pig. The supplemental, as  $H_3PO_4$ , and total phosphorus requirements were 0.13% and 0.47% of the diet, respectively, for maximum average daily gain and femur ash.

3. The total phosphorus requirement for the weanling pig fed a low-phosphorus purified diet was found to be between 0.20% and 0.35% for maximum growth performance and between 0.37% and 0.45% for maximum femur ash. The data indicated that the requirement for maximum growth performance was less than that for maximum femur ash.

4. Blood inorganic phosphorus level was influenced by dietary phosphorus. Blood inorganic phosphorus was rapidly depleted when a phosphorus-deficient diet was fed and it was even more rapidly restored when supplemental phosphorus was administered in the diet. A diurnal variation in blood phosphorus level was noted. The diurnal variation was not the same for the various sources of supplemental phosphorus. The level of blood phosphorus was influenced by the rate of absorption of the source of phosphorus, as well as, by the total amount of phosphorus absorbed. Inorganic blood phosphorus level, as measured at any one time, was not a valid criterion for the comparison of sources of phosphorus as to their total availability, except possibly for those sources that have been shown to be absorbed at the same relative rate.

5. Tail ash value did not adequately reflect femur ash value and could not be used as a substitute for femur ash in either the determination of the phosphorus requirement or phosphorus availability.

6. Mineral balance, femur ash level, and growth performance may all be used in evaluating sources of phosphorus. The preferred criterion depends upon the degree of precision desired, the facilities available, and the particular objective of the investigation. The balance technique gave, by far, the best precision with a limited number of observations. Femur ash yielded values of availability comparable to the mineral balance technique, however, it was a far less precise measurement. Phosphorus availability values were more difficult to obtain with growth performance because of the low phosphorus requirement

for maximum performance. In addition, the availability values obtained from growth performance were not the same as those obtained with femur ash or the mineral balance technique, however, they may be the most important values from a practical standpoint.

7. The per cent net utilization values calculated from the data of the mineral balance study were 100, 70, 43, 69, and 86 for  $NaH_2PO_4 \cdot H_2O$ , steamed bone meal, soft phosphate, dicalcium phosphate, and  $H_3PO_4$ , respectively.

Microfilm \$2.50; Xerox \$5.80. 116 pages.

#### MINERAL REQUIREMENTS OF THE CHICK WITH SPECIAL REFERENCE TO POTASSIUM, SODIUM AND MAGNESIUM AND THEIR INTERRELATIONSHIPS.

(L. C. Card No. Mic 60-3957)

Gerald Wayne McWard, Ph.D.  
University of Illinois, 1960

The requirements of the chick for potassium, sodium and magnesium and their interrelationships have been studied using a glucose-isolated soybean protein diet. The requirement of each was established with all other nutrients supplied in adequate quantities.

The potassium requirement for growth was found to be 0.21% of the diet. Feeding a super-optimal level of phosphorus was found not to alter the chick's requirement for potassium. The level of protein in the diet, at or above the chick's requirement for protein was found not to influence the potassium requirement of the chick. However, below the protein requirement of the chick, the potassium requirement was lowered.

A much lower sodium requirement of the chick was found than had previously been reported in the literature. A dietary sodium level of 0.11% was shown to promote optimal growth.

A "magnesium free" diet was formulated to determine the magnesium requirement of the chick. A level of 225 p.p.m. of magnesium promoted optimum chick growth and survival.

The potassium and sodium interrelationship of the chick was investigated employing both growth studies and tissue analyses. The sodium requirement of the chick was not altered by the level of dietary potassium fed. At all levels of sodium tested, the chicks continued to show a growth response to levels of potassium greater than the requirement value established (0.21%).

Potassium and sodium analyses of tissues revealed that dietary potassium did not change the sodium or potassium content of either whole blood or heart tissue. Increasing the level of dietary sodium increased the sodium concentration in both whole blood and heart tissue, while potassium concentration was unchanged. The sodium content of whole blood and heart tissue increased up to the dietary sodium level (0.11%) required for growth. An inverse relationship was found for the sodium and potassium content of skeletal muscle. When the dietary potassium was increased, muscle potassium increased and muscle sodium decreased. The relationship held until the level of potassium (0.24%) approximated the requirement of the chick for growth (0.21%) was exceeded. Each level of dietary



sodium increased muscle sodium. The potassium content of skeletal muscle was decreased when the level of dietary sodium was increased from 0.06% to 0.12% but a level in excess of the requirement for optimal growth (0.11%) was without effect.

Chick growth was used as the criterion to investigate the interrelationship of both potassium and sodium to magnesium in chick nutrition. No mutually sparing action (interrelationship) could be demonstrated for potassium, sodium and magnesium.

Microfilm \$2.50; Xerox \$5.80. 118 pages.

#### THE ROLE OF TRYPTOPHAN IN ANIMAL NUTRITION

(L. C. Card No. Mic 60-3972)

Richard Albert Notzold, Ph.D.  
University of Illinois, 1960

The tryptophan requirement of the weanling pig, the characterization of a tryptophan deficiency in the pig, the influence of the protein level on the tryptophan requirement of the rat, and the effect of antibiotics and tryptophan on the nitrogen utilization of the pig was studied. The influence of antibiotics and tryptophan on the nitrogen retention of chicks maintained under "disease-free" and contaminated conditions and the effect of oxytetracycline on the tryptophan requirement of the chick were also studied. In addition the effect of oxytetracycline on the ability of the chick to utilize D-tryptophan was investigated.

Weanling pigs, individually fed *ad libitum*, required approximately 0.13 percent dietary tryptophan for maximum weight gain on corn-meat and bone scraps, corn-hydrolyzed casein or corn-fishmeal rations containing 14 percent protein.

A 35-day tryptophan deficiency had no effect on the erythrocyte count, hematocrit, hemoglobin level, thyroid weight (expressed as a percent of live body weight) or the elaboration of pituitary growth hormone in the growing pig.

Growing rats receiving corn-hydrolyzed casein-glucose diets containing 12, 18, 24, 30 or 36 percent protein required no more than 0.095 percent L-tryptophan for optimum weight gain. At the various protein levels the amino acid ratios were made identical by varying the proportions of a corn-hydrolyzed casein mixture and glucose. Although the tryptophan requirement apparently did not change with the protein level of the diet, the weight gains at the suboptimal levels of tryptophan (below 0.095 percent) varied inversely with the protein level.

Nitrogen balance trials with the growing pig revealed that the addition of a combination of antibiotics (12 mg. each of oxytetracycline, procaine penicillin and streptomycin per pound of diet) or of tryptophan to a tryptophan-deficient corn-fishmeal ration increased nitrogen retention and nitrogen apparently digested. The presence of a significant interaction between tryptophan and the antibiotic mixture for nitrogen retained ( $P < 0.05$ ) suggests that the antibiotic spared dietary tryptophan in the weanling pig.

The nitrogen retention of chicks receiving corn-hydrolyzed casein diets which were deficient in tryptophan was improved by tryptophan supplementation. Tryptophan also tended to reduce thyroid weight; however, this effect

was not statistically significant. Neither antibiotic supplementation (210 mg. of equal parts oxytetracycline, procaine penicillin and streptomycin per kg. of diet) nor chicken excreta had any effect on nitrogen utilization or thyroid weight and the interaction between tryptophan and antibiotic was not significant.

It was felt that the reluctance of the chicks to consume the diets, which were extremely hygroscopic in nature, and the presence of several sick animals seriously impairs the validity of the conclusions that can be drawn from this experiment.

Chicks receiving graded levels of L-tryptophan (one level of DL-tryptophan was also fed) on a corn-hydrolyzed casein diet with or without 200 mg. of oxytetracycline per kg. of diet required approximately 0.16 percent tryptophan for optimum weight gain. The chicks were individually fed *ad libitum* for a 21-day period.

It was observed that oxytetracycline had no effect on the weight gain or the tryptophan requirement of the animals. The chick appeared capable of utilizing approximately 17 percent of the D-isomer which was present in a racemic mixture of tryptophan calculated to supply a sub-optimal amount of the L-isomer. The rather high incidence of perosis on this diet indicated the presence of a nutritional imbalance.

Microfilm \$2.50; Xerox \$5.00. 96 pages.

#### AGRICULTURE, FORESTRY AND WILDLIFE

##### ESTIMATION OF VITAL CHARACTERISTICS OF MICHIGAN DEER HERDS

(L. C. Card No. Mic 60-3412)

Lester Lee Eberhardt, Ph.D.  
Michigan State University, 1960

Major Professor: George A. Petrides

This study was conducted to analyze certain methods of estimating the relative abundance and vital characteristics of the white-tailed deer (*Odocoileus virginianus*) in Michigan. The study covers the years 1952 to 1958, with major emphasis on northern Lower Peninsula deer herds.

Deer population estimates from the pellet-group count method were used in the study. Extensive field experience with the method, as well as tests on areas of known deer populations, however, show that it cannot as yet be accepted as a wholly reliable standard by which to judge other methods of estimating deer population size.

Population estimates based on sex, age, and kill data from the hunting harvest were found to be feasible on the assumption of a low rate of non-hunting mortality in adult male deer. Precise population estimates could be made only for the earlier years of the study (1952 and 1953). The assumption of an exponential kill-effort relationship was necessary to compute estimates for subsequent years. The possibility of differential harvest rates was considered, and an under-representation of fawns in samples of the kill was found to be the most important effect in Michigan.

Evaluation of adult buck population estimates derived

from data on legal kill and hunting effort demonstrated that vulnerability to hunting is not constant. Positive identification of the underlying causes could not be established from the available data, but the evidence suggested two major aspects: a sharp decline in vulnerability during the first week of the hunting season, and an inverse relationship between number of hunters per unit area and hunter-efficiency. Estimation of the proportion of the deer population taken per unit of effort (hunter-day) was further complicated by the necessity of using a biased method of estimation, and by a marked decline in hunting effort during the season. Results of the study show that kill-effort data probably cannot be used to produce direct and trustworthy estimates of deer population densities until more information is available on the behavior of deer and of hunters.

A method was demonstrated for combining different indices of deer population levels through linear transformations. Several possible criteria for evaluating indices were investigated. It was shown that the lack of absolute measures of deer population levels precludes a completely objective choice of methods for weighting different indices in combining them into a single measure. The chief disadvantage of a combined index was considered to lie in its not providing direct estimates of numbers of deer, while the major advantages were found to be ease in maintaining a continuity of records and low cost of basic data.

Comparisons were made of three independent methods of estimating deer population levels, pellet-group counts, the sex-age-kill method, and the combined index. A high degree of correlation among the methods was demonstrated.

Useful estimates of deer survival rates were shown to require a knowledge of the age and sex structure of the herd as well as of the population level in at least two successive years. Rates estimated from the age structure alone were found to be unsatisfactory under Michigan conditions except possibly as representing an average survival value over a span of years. Under-representation of fawns in samples obtained during the hunting season caused considerable difficulty in estimating survival rates for this class. Results of sample surveys for over-winter herd losses were appraised. Illegal kill was considered to be a major mortality factor for antlerless deer.

The dynamics of Michigan deer populations were studied by comparing rates of change calculated directly from annual measures of population level with rates synthesized from data on reproductive and survival rates. Close agreement was noted in an area where the deer population had apparently reached a stable age distribution. Reproductive rates were shown to vary inversely with deer population densities. A maximum possible sustained annual mortality rate for adult female deer in northern Michigan was estimated to be about .30, while the much higher reproductive rates observed in the two youngest adult female age-classes in southern Michigan apparently would sustain a mortality coefficient approaching .40.

Microfilm \$2.70; Xerox \$9.45. 206 pages.

# AN INVENTORY AND STUDY OF THE HISTORICAL DEVELOPMENT OF THE MAJOR RESOURCES OF MARQUETTE COUNTY, MICHIGAN.

(L. C. Card No. Mic 60-3421)

Roger Lawrence Norden, Ph.D.  
Michigan State University, 1960

Major Professor: G. W. Mouser

The management or wise use of our natural resources is one of the major problems of the world today. An area can realize its potentialities only through planning based on a knowledge of the nature and extent of its natural resources obtained from a detailed survey of their major resources.

The major resources of Marquette County with which this survey is concerned include the minerals, water, soils, fish, wildlife, forests, and the human resource. The present status of the resource in Marquette County is given in this report along with the history of its development, and the economic implications for the future.

This survey could serve as a guide in the future planning and utilization of the resources of the county. By providing concise information on the major resources of the county, this report should help further the instruction of conservation in the schools of the area.

Marquette County, located in the north-central part of the Northern Peninsula of Michigan, is Michigan's largest county. It contains 1,841 square miles with sixty-eight miles of shoreline on Lake Superior. The population of the county, according to the 1950 census was 47,654. It was estimated that on January 1, 1958 there was a population of 50,500 in the county.

The major findings of this report show that Marquette County is bountifully endowed with natural resources, particularly iron, forests, water, fish, wildlife, and recreational features. Within its borders are found more inland lakes (835) and more miles of stream (1,906) than are found in any other county of Michigan. The abundant supply of fresh water for industrial purposes represents one of the county's principal long-range attractions for industry. Natural gas is foreseen as a future source of power.

Iron ore provides the main source of income in the county. More than 275 million long tons of ore have been produced on the Marquette Range since iron was first discovered here in 1844. It is believed that the iron ore reserves in this county are sufficient for many decades of continued mining activity, especially with the continued research in the field of beneficiation.

More than ninety per cent of the county is considered forest land. Of this forest area, commercial forest land occupies 1,121,300 acres. This provides forest products, considerable areas for wildlife production, and recreation. The tourist and resort industry is rapidly becoming one of the major sources of income in the county.

Because of the topography, sandy soils, and the short growing season, much of the land is not suited to intensive agriculture. The principal agricultural enterprises are dairying and potatoes. Of the total employed in the county, only three and one-half per cent are employed in agriculture. Marquette County was the first in Michigan to produce a one-thousand bushel per acre yield of potatoes.



In conclusion, this is a county rich in natural resources, scenic beauty, historic lore, and containing a vast potential for future development.

Microfilm \$3.85; Xerox \$13.50. 298 pages.

## AGRICULTURE, PLANT CULTURE

### INFLUENCE OF NUTRIENT-ELEMENT SUPPLY ON LEAF COMPOSITION AND GROWTH OF Highbush Blueberry (*Vaccinium corymbosum* L.) WITH SPECIAL REFERENCE TO IMPORTANCE OF SAMPLING DATE ON LEAF AND FRUIT COMPOSITION OF FIELD GROWN BLUEBERRIES

(L. C. Card No. Mic 60-3397)

Harry James Amling, Ph.D.  
Michigan State University, 1958

Major Professor: A. L. Kenworthy

One- and two-year-old rooted cuttings of the highbush blueberry *Vaccinium corymbosum* L., were grown in quartz sand and in vermiculite under varied levels of ten nutrient elements. Leaf analyses and plant response to treatment in terms of foliar expression, root development and growth were recorded and discussed. In addition, leaf and fruit samples were collected biweekly in the summer of 1957 to ascertain seasonal influence on leaf and fruit composition. Commercial blueberry fields were also surveyed for nutritional disorders. Leaf analyses, photographic and descriptive records were collected of the nutritional disorders observed.

In sand culture the leaf content of N, P, K, Mg, Ca, B and Mn increased as the supply of the element increased. Iron and copper increased in the leaf only when a high external supply existed. With vermiculite only, K and B increased in the leaf as the supply of the element increased. Mn, Fe and Cu leaf levels increased only when solutions containing high levels of the elements were used.

Numerous nutrient interrelations became apparent when the concentration of particular nutrient elements in solution were varied. The more prominent relationships are as follows: (1) As the supply of nitrogen increased, all elements except phosphorus decreased in the leaf. (2) A shortage or excess of phosphorus decreased the nitrogen level in the leaf. (3) As the supply of potassium or magnesium increased from 0 ppm to 30 ppm or 24 ppm, respectively, the antagonistic influence of potassium on the uptake of magnesium was equal in severity to the reciprocal antagonism exerted by magnesium on potassium uptake. With further increases in the supply of these two elements, the antagonistic influence of potassium on magnesium uptake was less severe than the reciprocal antagonism of magnesium on potassium uptake. (4) Iron showed a strong antagonistic influence on the uptake of manganese. Manganese did not exhibit a reciprocal relationship on iron. (5) A low level of any one of the major elements in solution resulted in a high manganese leaf level. (6) A low level of calcium in solution promoted the accumulation of

the heavy metal nutrient-elements, magnesium and potassium in the leaf. (7) The potassium level in the leaf increased with increased supply of boron.

Characteristic leaf pigmentation of N, P and Mg deficiencies appeared sooner and were more conspicuous under high amounts of solar radiation. Under low amounts, these same symptoms faded, or in the case of magnesium deficiency, developed completely different characteristics. A shortage of any one of the nutrient elements, except nitrogen and phosphorus, and an excess of all nutrient elements, except phosphorus, were associated with the occurrence of a chlorosis or necrosis, or both.

There appeared to be an increased requirement for most major nutrient elements, except potassium, as the amount of solar radiation increased. Correspondingly, there was an increased requirement for potassium when the amount of solar radiation decreased. Under low solar radiation the high potassium treatment induced the greatest amount of growth, while under high solar radiation the high phosphorus treatment resulted in the greatest amount of growth.

Low nitrogen levels in solution stimulated root growth, while high N, B, Mn, Fe and Zn and low Ca, B, Mn solution levels noticeably reduced root development. The high phosphorus treatment induced the most desirable root system.

Blueberry plants were found to grow well in agricultural vermiculite if supplied with nitrogen and phosphorus. Plants growing in vermiculite showed noticeable reductions in growth when supplied with potassium or iron.

Definite seasonal trends existed for all nutrient elements in the leaves except boron. N, K, P, Cu decreased, while Mg, Ca, Fe, Mn and Zn increased in varying degrees as the season progressed. The biweekly leaf sampling study also indicated that the greatest consistency in the leaf content of all nutrient elements occurred during the three week period prior to, and including, the first week in which 35 percent of the crop could be harvested.

Considerably more manganese was found in leaves of the Jersey variety than in leaves of the Rubel variety. Foliar symptoms of magnesium deficiency were associated with a much higher medial leaf content of magnesium with Rubel than with Jersey. This was interpreted to mean that Rubel has a higher requirement for magnesium than Jersey. Rubel fruit contained higher amounts of K and N, and lower amounts of Ca and Mn than did Jersey fruit. Rubel fruit showed lower keeping quality than Jersey when N and K were higher, and Ca lower than average.

All nutrient elements in the fruit declined with increased maturity. There were, however, considerable differences in the magnitude of decline between elements. The percent decrease of these elements during the six weeks period prior to harvest were as follows: Mn - 73 percent; B - 61 percent; Ca - 59 percent; P - 55 percent; N - 54 percent; Mg - 41 percent; Fe - 29 percent; Cu - 24 percent; and K - 20 percent. During the harvest period N, K and Ca decreased significantly.

The nutritional disorder survey indicated the existence in 1957 of shortages of N, P, Mg and Ca, and excesses of N, K and Mn in commercial fields.

Microfilm \$2.55; Xerox \$8.80. 195 pages.

# BREEDING FOR EXTREMES IN LODGING RESISTANCE IN CORN BY RECIPROCAL RECURRENT SELECTION

(L. C. Card No. Mic 60-3881)

Parmanand Swarup Bhatnagar, Ph.D.  
University of Illinois, 1960

Source material consisted of advanced generations of all-possible 153 single crosses among 18 inbred lines in each of the two unrelated and genetically diverse sources, A and B. In 1954, source A plants were self-pollinated and outcrossed to a composite of 5 source B plants and vice versa.

Based on a replicated single hill performance of the test crosses in 1955, each of the two sources was further subdivided into a group of lines with low and a group with high lodging. The five selected lines in each lodging group of each source were crossed among themselves in all-possible combinations in 1956, to give ten  $F_1$  crosses. Selfing in these crosses in 1957 gave ten second cycle lines for low and ten for high lodging in each source. In 1958 these second cycle lines and the first cycle lines were selfed and outcrossed to appropriate testers made up of selected germplasm from the opposite source.

The trial of the test crosses in 1959 revealed that there was no significant difference between two sources for any of the characters studied, with the exception of ear height, which was significantly different at 5 percent. However, there were highly significant differences between low and high lodging groups for percentage of erect plants in both sources. No significant differences were found for plant height between the two lodging groups. The high lodging group had significantly greater ear height than the low lodging group. The high lodging group gave significantly greater ear weight than the low lodging group in both sources. Theoretically, it may be postulated that plants susceptible to lodging are efficient translocators of carbohydrates to ears and thus tend to be higher yielding than the resistant plants.

There were no significant differences between the two cycles of selection for any of the characters studied, although the trends were in the desired direction in each cycle.

The trial of the original inbred lines and the lines evolved in two cycles of selection, revealed much the same picture as the test crosses. There was no significant difference between the two sources for any of the characters studied. Within each source, highly significant differences were found between the low and the high lodging groups for percentage of erect plants. Only the high lodging group in source A showed a straight line decrease in percentage of erect plants. In all other groups, the changes in percentage of erect plants from cycle to cycle were small. Ear height in both lodging groups of source A showed an increase in each cycle. In source B, ear height increased only in the high lodging group. Plant height increased in each cycle in high lodging group of both sources.

In two cycles, the mean percentage of erect plants of the original population was shifted from 71 percent to 83 percent in low lodging and from 71 percent to 29 percent in high lodging group of source A. In source B, the original population mean was moved from 62 percent to 81 percent in low lodging and from 62 percent to 32 percent in high lodging group. It is concluded that these shifts are largely

genetic in nature and have been induced by selection pressure and genetic recombination during two cycles of selection.

It appears that reciprocal recurrent selection for resistance to lodging has been effective in separating the original population into two distinct subgroups with low and high lodging in both sources. However, this study has also revealed that severe selection pressure for lodging resistance tends to be associated with decreased ear weight in corn. Microfilm \$2.50; Xerox \$3.80. 69 pages.

# THE BREEDING BEHAVIOR OF YIELD COMPONENTS IN ALFALFA

(L. C. Card No. Mic 60-4167)

Rodney Vance Frakes, Ph.D.  
Purdue University, 1960

Major Professor: Fred L. Patterson

A replicated space planted clonal nursery consisting of ten genotypes of alfalfa was used to examine the effects of regrowth period on broad sense heritability estimates for dry matter yield per plant (gm.), natural width (cm.), natural height (cm.), length of the longest stem (cm.), and number of internodes on the longest stem. The data indicated that as regrowth period increased from 18 to 38 days, the broad sense heritability estimate for natural height increased from 91% to 97%, whereas for natural width this same estimate decreased from 86% to 56%. The heritability estimate also decreased for number of internodes from 51% to 25% as regrowth period increased. Regardless of regrowth period, the heritability estimate for dry matter yield approached the mean heritability estimate for width, height, and long stem measurements.

Multiple correlation coefficients for width, height, and long stem on dry matter yield showed that variation in these three variables accounted for 87% or more of the variation in dry matter yield.

A space planted progeny nursery, consisting of 4 parents, 4  $S_1$  families, 6  $F_1$  families, 6 reciprocal families, and 102  $F_2$  families, was used to examine the breeding behavior of the measurable yield components. A partial regression predictive equation, based on width, height, and long stem measurements, was found satisfactory to predict mean dry matter yield per plant for different families. These component measurements can be taken in less time than actual dry matter yield. This means that the alfalfa breeder may be able to examine many more entries in early stages of the breeding program, for relative yield performance through the use of measurable yield components, rather than actual yield data.

Based on entry means, the squared multiple correlation coefficient ( $R^2$ ) for width, height and long stem on yield was .73. When stem number was added as a fourth variable, the  $R^2$  increased to .93.

Ten of the twelve single crosses exhibited a significant inbreeding depression for dry matter yield, based on a multiple range test for significance. In each case, one or more of the components likewise exhibited a significant inbreeding depression. Where no significant inbreeding depression was observed for yield,



none of the components showed an inbreeding depression.

The possible use of broad sense heritability estimates, along with progeny families, to determine the additive and non-additive portion of total genetic expression for a given variable was outlined. It was suggested that once genetic components were determined for a given set of variables, the character response in crossing may be predicted within limits from character measurements on the parental types.

The path-coefficient analysis of correlation coefficients indicated that stem number was highly associated with yield, but the association was indirect through leaf weight and stem weight.

Using single crosses and reciprocals, the diallel analysis indicated that natural height and length of the longest stem respond to the effects of general combining ability, whereas natural width and number of stems per plant respond to the effects of specific combining ability. Dry matter yield was intermediate among the four components in response to general and specific combining ability. These findings were substantiated by parent-progeny ( $F_2$  on  $F_1$ ) squared correlation coefficients, in that this statistic was high for the characters responding to general combining ability, and low for those responding to specific combining ability. This indicates that greater progress may be expected if the forage breeder will use breeding procedures to take maximum advantage of both, general and specific combining ability.

Microfilm \$2.50; Xerox \$6.40. 134 pages.

#### INHERITANCE OF THE FLUORESCENCE CHARACTERISTIC IN CERTAIN CULTIVATED OAT VARIETIES

(L. C. Card No. Mic 60-3954)

William Calvin Martin, Ph.D.  
University of Illinois, 1960

Fluorescence has gained a certain amount of popularity as a characteristic by which the seed of oat varieties may be classified as to their reaction when placed under ultraviolet light--thus a factor in varietal purity determinations. Relatively little genetic data is available upon the inheritance of the fluorescence characteristic in oats. This study was initiated in the spring of 1957 in an attempt to obtain additional information concerning the inheritance of the fluorescence characteristic in cultivated oats, *Avena sativa*, L.

Oat varieties are classified as fluorescent or non-fluorescent on the basis of the reaction of the outer surface of the lemma and palea of the mature seed. The lemma and palea are maternal tissues and any change in fluorescence reaction resulting from hybridization does not appear until the next generation. Thus  $F_0$  seeds (seeds produced on maternal plants as the result of hand pollination) naturally have the fluorescence characteristic of the maternal parent, and segregation does not appear until  $F_2$  seeds are formed on  $F_2$  plants.

Crosses were made in all possible combinations among the fluorescent varieties Nemaha (C.I. 4301), Bonda (C.I. 4329), Jaipur (C.I. 5190) and Missouri 0-205 (C.I. 4988), and the non-fluorescent varieties Andrew (C.I. 4170),

Clinton 11 Lot 25 (C.I. 4606) and Fayette (C.I. 6916), since previous workers had not been in agreement about which was the dominant characteristic, fluorescence or non-fluorescence. It was also not known if varieties of similar fluorescence classification had similar genotypes for the fluorescence characteristic.

The results from examination of the seed of the  $F_1$  plants established that, in the crosses studied, fluorescence was dominant to non-fluorescence.

Segregating progenies of 20 crosses (data from reciprocal crosses were pooled, since no differential reaction was observed) were examined under ultraviolet light and classified for fluorescence and non-fluorescence. The mode of inheritance of the fluorescence characteristic was studied from the classifications of seed from  $F_2$  plants and  $F_3$  progenies of  $F_2$  plants of the 20 crosses. One of two independent major factors governing the fluorescence characteristic were postulated for the various crosses classified. It was proposed that the fluorescent variety Jaipur may carry three independent major factors governing the fluorescence characteristic. The Nemaha and Bonda varieties apparently possess the same dominant allele governing fluorescence, while Missouri 0-205 apparently carries two dominant independent major genes, one of which is allelic to that carried by Nemaha and Bonda. Both genes were recessive in the varieties Andrew, Clinton 11 Lot 25 and Fayette.

The practical application of the fluorescence test and the physiological basis for non-fluorescence were discussed.

Microfilm \$2.50; Xerox \$3.00. 39 pages.

#### PHYSIOLOGICALLY INDUCED MORPHOLOGIC AND PATHOGENIC VARIATIONS OF SOME *GLOMERELLA CINGULATA* ISOLATES

(L. C. Card No. Mic 60-1521)

James Walter Strobel, Ph.D.  
Washington State University, 1959

Supervisor: Professor Shirl O. Graham

The earlier part of this investigation dealt with the identification, isolation, and inoculation of the organisms associated with anthracnose of foliage plants. The incidence of this disease was shown to have increased greatly during the past three years.

The incitant of anthracnose on foliage plants was identified as *Glomerella cingulata* (Stonem.) Spauld. et v. Schrenk. Certain infections on diverse hosts manifested setae on the acervuli, other infections on different hosts produced acervuli devoid of setae. The presence of setae on acervuli has long served to distinguish the imperfect genus, *Colletotrichum*, from *Gloeosporium*. Utilizing this traditional criterion one or more stages of this organism was identified on forty-three different species or varieties of foliage plants. New United States or Washington State records are listed.

Isolates from these hosts were not stable in manifesting setae in pure cultures. Isolates obtained from non-setal bearing acervuli produced setae in culture, others remained unchanged. Isolates from setal bearing acervuli often failed to produce setae in culture.

Similarly, occurrence of setae on the acervuli produced on host tissues by these isolates subsequent to inoculations was erratic. Non-setal isolates produced setae on certain hosts, and some setal bearing isolates failed to produce setae. These results were in accord with observations of many previous investigators.

The latter part of this investigation incorporated in vitro cultural and genetic studies which attempted to elucidate mechanisms governing the variation in the production of setae. When grown on nine standard media isolates were either strong, intermediate, weak or non-setal producers. Each isolate appeared to possess an innate tendency for one of these characteristics.

Extracts from Dieffenbachia amoena leaves inhibited setal production of an isolate from this host which was a strong setal producer on standard media. Inhibition occurred when the isolate was grown on media incorporating ether extracts, or fresh leaf (sap and homogenate) additives. Results indicate that naturally occurring compounds influence the production of setae.

Of thirteen growth substances tested, only choline chloride stimulated growth. However, arrested growth occurred when the isolates were cultured on several growth substance augmented media, e.g. uracil, thiamin, and pyridoxine. The setal responses of isolates remained essentially unchanged on augmented media. Certain isolates produced setae more prolifically in the light.

The alterable nature of setal production was again illustrated on media augmented with different carbohydrates or carbohydrate derivatives. Setal production of one isolate was inhibited by *i*-erythritol and alpha chloralose. The inhibition induced by *i*-erythritol was permanent for all subsequent subcultures, whereas that induced by alpha chloralose was permanent only when recultured on alpha chloralose.

Certain isolates produced setae over a wide range of temperatures, others were more temperature sensitive, manifesting setae over a more limited range.

Monoascosporic lines isolated were either setose or non-setose. Most attempts to associate setal production with heritable characteristics such as Sporulation (clumped or scattered perithecial types) failed. On certain standard media, one set of setal producing monoascosporic lines tended to produce more abundant setae in cultures exhibiting the scattered perithecial type.

It was demonstrated that setal production of monoascosporic lines could be altered by cultural means. Certain growth substances, such as ascorbic acid and calcium pantothenate, as well as various standard media inhibited setal production in lines considered setal producers.

In no case was the scattered perithecial type isolated directly from natural infections. Scattered and clumped perithecial types derived from the same host or different host were compatible.

The conclusions, (1) that all isolates studied are but strains of one organism, Glomerella cingulata, and (2) that setal production is readily alterable by various means, and hence an unstable morphologic character, led the author to accept von Arx's (1957) concept of the genus Colletotrichum.

Microfilm \$2.50; Xerox \$7.20. 151 pages.

AGRICULTURE, PLANT PATHOLOGY

VARIATION IN THE TOMATO LEAF MOLD ORGANISM, Cladosporium fulvum Cke.

(L. C. Card No. Mic 60-4147)

Rita Barr, Ph.D.  
Purdue University, 1960

Major Professor: Mark L. Tomes

Variability in Cladosporium fulvum is caused by mutation. It may also result from heterocaryosis and the chance dissociation of nuclei. This study surveyed variability and dealt with the establishment of heterocaryosis in the tomato leaf mold organism.

In Part I of this thesis the extent of color variability of Cladosporium fulvum during three generations of single-spore was investigated. The results obtained established the existence of two contradictory phases: a constant and a variable one. All clones derived from a single spore showed remarkable similarity and constancy of color and cultural characteristics up to the fourteenth day of their life cycle. Thereafter yellow or white color variants began to appear as pinpoint patches on top of the olive-green mycelium. These had been noted by ether investigators and explained on the basis of a high mutation rate. Their appearance could also result from the dissociation of heterocaryotic nuclei in vegetative cells. Since color of the mycelium did not remain constant, other genetic markers were used to establish heterocaryosis in Cladosporium fulvum.

In Part II methods for obtaining biochemical mutants from irradiation of spores with ultra-violet light were described. A total of seven biochemical mutants requiring single supplements, such as lysine, glutamic acid, arginine, inositol, and cystine, were recovered. They were tested in combinations of two on minimal medium to see if heterocaryosis occurred.

Two types of heterocaryon tests were described and discussed in Part III. Mixtures of six biochemical mutants in various pairs plated directly on minimal medium gave no growth. However, when these mixtures were allowed to grow on complete medium for a generation before transferring them to minimal medium, two combinations consistently behaved as prototrophs. They were mutant pairs, 2 plus 6 requiring lysine and glutamic acid, and 7 plus 11 requiring glutamic acid and arginine, respectively. These particular combinations were able to grow on minimal medium as well as wild type. All other combinations failed. Since the control plates with single mutants showed no growth on minimal medium even after growth for a generation on complete medium, and since all cross-feeding tests by simple diffusion of substances through the agar also gave negative results, heterocaryosis was presumed to occur in mixtures of mutants 2 plus 6 and 7 plus 11. In testing the progeny of single spores isolated from the original heterocaryons, both parental types were recovered from the mixture 2 plus 6. One parental type was found to be predominant. The ratio between the two parental type spores recovered was 1 lysineless: 84 glutamic acidless. Cytological studies showed the presence of anastomoses in both single and mixed cultures of the fungus. Binucleate spores occurred with a frequency of 1:200 in both



parental types. They were also observed in mixtures of 2 plus 6.

These considerations imply that heterocaryosis may be responsible for variation in *Cladosporium fulvum*. Contradictory evidence was obtained from the inability of heterocaryons to be transferred from minimal to minimal medium by means of spores. This failure could be explained by the production of spores which were of one or the other parent type. Transfers of whole colonies or pie-shaped sectors from minimal to minimal medium were successful. Microfilm \$2.50; Xerox \$4.00. 91 pages.

STUDIES ON MAINTENANCE OF VIRULENCE  
OF *CORYNEBACTERIUM INSIDIOSUM*  
(MC CULL.) H. L. JENS. IN CULTURE AND  
THE INHERITANCE OF RESISTANCE TO  
*C. INSIDIOSUM* IN DIPLOID *MEDICAGO*  
*FALCATA* L.

(L. C. Card No. Mic 60-4151)

Bertram Emil Bordewick, Ph.D.  
Purdue University, 1960

Major Professor: Kirk L. Athow

The effects of selected media, temperatures and aerobism on maintenance of virulence of *Corynebacterium insidiosum* (Mc Cull.) H. L. Jens. in pure culture were investigated. Cultures of two isolates of *C. insidiosum* which differed in virulence were maintained for 20 months in test tubes on potato dextrose agar (PDA), PDA plus safranin, and alfalfa agar at 24, 5 and -30°C either under oil or not under oil. Virulence was measured by the severity of symptoms produced in inoculated plants of the susceptible alfalfa variety, Narragansett. The more-virulent isolate remained virulent 3-6 months longer than the less-virulent isolate. Cultures at 5°C remained virulent 3 months longer than at 24°C and 3-6 months longer than at -30°C. At 5°C cultures on alfalfa agar and on PDA plus safranin retained virulence about 3 months longer than those on PDA. Those under oil retained virulence 3-6 months longer than those not under oil. None was virulent after 20 months.

Possible differences in colony growth between a highly-virulent and a weakly-virulent culture of *C. insidiosum* on a medium containing 2,3,5-triphenyl tetrazolium chloride were studied. Of seven highly-virulent cultures and four weakly-virulent cultures investigated all formed round, smooth, flat, pink colonies when observed by obliquely-transmitted light.

Two-way paper partition chromatography was employed in an effort to detect qualitative differences in amino compounds from extracts of a highly-virulent culture compared to a weakly-virulent culture of *C. insidiosum*. Butanol-acetic acid-water was used as the first solvent and phenol-ammonia as the second solvent. Ninhydrin was the location reagent. No differences in amino compounds were noted between extracts of the two cultures.

Inheritance of resistance to bacterial wilt in the diploid alfalfa species, *Medicago falcata* L., was studied in the F<sub>1</sub>, F<sub>2</sub>, and backcross progenies from diallel crosses among resistant and susceptible plants. The degree of susceptibility of the parents was established from disease reaction

of inoculated cuttings. The Kolmogorov-Smirnov Test was used to classify the parents as resistant, moderately-resistant, and susceptible. None of the parents was as resistant as the resistant variety, Ranger. None was more susceptible than the highly-susceptible variety, Du Puits. There was a wide variability both within and between F<sub>1</sub> populations. Moreover, selfing F<sub>1</sub> individuals resulted in wide variability within and between F<sub>2</sub> populations. The data indicate that resistance to bacterial wilt in diploid alfalfa is controlled by multiple genes. Limited backcross data showed that genes for resistance or susceptibility can be accumulated. The progenies from backcrosses to a susceptible parent were largely susceptible and progenies from backcrosses to a resistant parent were largely resistant. Microfilm \$2.50; Xerox \$3.80. 68 pages.

PHYSIOLOGICAL RESPONSES IN THE  
TOBACCO PLANT TO PATHOGENESIS BY  
*PSEUDOMONAS SOLANACEARUM*, CAUSAL  
AGENT OF BACTERIAL WILT.

(L. C. Card No. Mic 60-3728)

Ellsworth Chapman Maine, Ph.D.  
North Carolina State College, 1960

Supervisor: Arthur Kelman

The invasion of tobacco stem tissue by *Pseudomonas solanacearum*, causal agent of southern bacterial wilt, was accompanied by marked increases in the rates of oxygen uptake. Enhanced respiratory rates also occurred in leaf tissues of inoculated plants that showed no evidence of bacterial invasion or wilting symptoms. Such increases could be attributed to a host response rather than to oxygen uptake directly involved in respiration of the pathogen.

The enzyme inhibitors, sodium fluoride, dinitrophenol, o-phenanthroline, and sodium diethyldithiocarbamate, had markedly different effects on the oxygen uptake of healthy and diseased stem tissues, indicating that a completely different pathway, possibly mediated by a noncytochrome metallocopper oxidase system, may be responsible for the enhanced oxygen uptake observed in diseased tissues.

On a dry weight basis, polyphenol oxidase activity doubled in affected stem tissues. A positive correlation existed between increased polyphenol oxidase activity and the increased oxygen uptake in different stages of disease development. Furthermore, enzyme inhibitors had similar effects on both the oxygen uptake and polyphenol oxidase activity of diseased tissues. As in the case of enhanced oxygen uptake, such increases in polyphenol oxidase activity could be attributed to a host response, since the wilt bacterium was not capable of oxidizing chlorogenic acid, the sole polyphenol substrate used in this investigation.

During pathogenesis, specific activities of enzymatic ascorbic acid oxidation increased between 200 and 400 percent on a dry weight basis during the first 48 hours of disease development. These increases were not correlated with enhanced oxygen consumption as pathogenesis progressed.

The soluble protein content of diseased stem tissues increased markedly as early as two days after inoculation, but further increases were not evident as pathogenesis

progressed. The total soluble nitrogen content of affected tobacco stem tissues also increased substantially.

Oxygen uptake of previously healthy tobacco stem tissue segments increased almost immediately after being placed in contact with washed, viable *P. solanacearum* cells. The greatest portion of this increase was apparently a host response. Nondialyzable, heat-labile compounds in culture filtrates of the wilt bacterium caused increases in the rates of oxygen consumption and polyphenol oxidation in treated tobacco stem tissues. Similar effects were caused by partially purified extracellular pectolytic and cellulolytic enzymes obtained from *P. solanacearum* as well as from commercial sources.

Oxygen uptake, polyphenol oxidase activity, and enzymatic ascorbic acid oxidation were generally stimulated to a greater extent in diseased susceptible than in diseased resistant stem tissues. However, such changes were correlated with differences that were apparent in the degrees of pathogenesis rather than with either resistance or susceptibility.

The results of this investigation indicate that increased polyphenol oxidase activity may account for a portion of the increased oxygen consumption observed in diseased tobacco stem tissues after pathogenesis has progressed through its initial phases. The immediate responses in oxygen uptake that occur during the first 48 hours of pathogenesis may be a reflection of enhanced ascorbic acid oxidation and/or protein synthesis. Furthermore, extracellular hydrolytic enzymes produced by the wilt bacterium which affect the structural integrity of host tissues may be important factors in the initiation of enhanced oxygen uptake in tissues affected by southern bacterial wilt, rather than toxins, which affect the essential physiological processes of host tissues.

Microfilm \$2.50; Xerox \$6.40. 131 pages.

#### PHYSIOLOGICAL STUDIES OF SPECIES OF HELMINTHOSPORIUM PARASITIC ON CORN

(L. C. Card No. Mic 60-4187)

Isaac Malca Maloul, Ph.D.  
Purdue University, 1960

Major Professor: Arnold J. Ullstrup

A study of some of the factors which affect growth and sporulation of *Helminthosporium turcicum* Pass. and *H. carbonum* Ullstrup was made. All of the isolates used originated from single conidia.

Among several carbon sources tested maltose, glucose, and sucrose were most efficiently utilized in growth while sorbose and arabinose were poorly assimilated by isolates of *H. turcicum* and *H. carbonum*. Lactose stimulated sporulation more than any other single carbohydrate; however, mixtures of sorbose and glucose enhanced sporulation of *H. turcicum* more than lactose. A high frequency of empty spores of *H. turcicum* occurred on media containing sorbose; the deleterious effects of this sugar should be investigated further.

Organic nitrogen (casein hydrolysate, asparagine) was utilized most efficiently in growth. Ammonium nitrogen was poorly utilized, possibly because the pH of culture

filtrates decreased markedly soon after initiation of growth. Not all isolates sporulated best on the same nitrogen source. The results indicate that the carbon source used in the medium may determine which nitrogen source is utilized most effectively in spore production.

All isolates within a species did not respond equally to the various treatments investigated. Variability in these species is not limited to pathogenicity and cultural characteristics, but isolates also differ in biochemical activity. The amount and rate of growth of isolates may determine to a large extent the factors which favor sporulation.

Attempts were made to induce mutations which would alter the virulence race I of *H. carbonum*. None of the mutants obtained after treating spores and mycelium of the fungus with ultraviolet light, 5-bromouracil, and 2,6-diaminopurine were stable.

Microfilm \$2.50; Xerox \$4.60. 86 pages.

#### PATHWAYS OF GLUCOSE CATABOLISM IN CALDARIOMYCES FUMAGO WORONICHIN

(L. C. Card No. Mic 60-3979)

S. Ramachandran, Ph.D.  
University of Illinois, 1960

The pathways of glucose catabolism in *Caldariomyces fumago* Woronichin, a filamentous fungus belonging to the family Moniliaceae of the Fungi Imperfecti, was investigated.

The fungus converts all the glucose supplied as substrate to 2-ketogluconate by means of the "notatin" type enzyme glucose oxidase and gluconic acid oxidase. Since the enzymes glucokinase and gluconickinase are absent, the Embden-Meyerhof-Parnas pathway and the typical hexose-monophosphate and Entner-Doudoroff pathways are not present in *C. fumago*.

After a short period of adaptation, the 2-ketogluconate is apparently phosphorylated and then reduced to form 6-phosphogluconate. The oxidation data of 2-ketogluconate and 6-phosphogluconate by preincubated cells indicate that 6-phosphogluconate occurs as an intermediate beyond the 2-ketogluconate step in the dissimilation of glucose. The similarity in the amounts of pyruvate produced indicates that glucose, 2-ketogluconate, and 6-phosphogluconate are utilized via the same pathways. This similarity in the amounts of pyruvate formed and experiments with 1-C<sup>14</sup> labeled glucose indicate that *C. fumago* utilizes about 65% of glucose via a modified Entner-Doudoroff pathway and the remaining 35% via a modified hexose-monophosphate pathway.

The pyruvate produced by the modified pathway is oxidized further via the tricarboxylic acid cycle as evidenced by the ability of the cells to utilize tricarboxylic acid cycle intermediates.

The presence of the following enzymes was demonstrated--glucose oxidase, gluconic oxidase, phosphoglyceromutase, enolase, pyruvickinase and isocitric dehydrogenase.

Thus, *C. fumago* is unusual in that it utilizes parts of a number of pathways in glucose catabolism to pyruvate. The initial oxidation of glucose is through the notatin type of oxidation to 2-ketogluconate. This, then probably



proceeds to 6-phosphogluconate via the adaptive enzymes 2-ketogluconickinase and 2-keto-6-phosphogluconic reductase. The 6-phosphogluconate proceeds to form pyruvate via the rest of the hexosemonophosphate pathway and Entner-Doudoroff pathway. The terminal oxidation of pyruvate occurs by the usual tricarboxylic acid cycle.

Microfilm \$2.50; Xerox \$4.60. 86 pages.

EFFECT OF ANTECEDENT AND IMMEDIATE  
ENVIRONMENT ON A SPECIES OF  
CEPHALOSPORIUM PRODUCING  
AN ANTIBIOTIC

(L. C. Card No. Mic 60-4137)

Glenn Edward Smith, Ph.D.  
The Ohio State University, 1960

In previous research, an organism, which was tentatively identified as a species of *Micromonospora*, was isolated from an apparently healthy tomato plant, previously inoculated with *Fusarium oxysporum* f. *lycopersici*, causal agent of *Fusarium* wilt of tomato. The *Micromonospora* sp., now named *Cephalosporium* sp., had an inhibitory effect upon *Fusarium* in vitro and in vivo. A further elucidation of the characteristics of the inhibitory fungus and its filtrate was deemed a natural avenue of investigation. Concurrently a study of the effects of antecedent and immediate environments on the *Cephalosporium* and the subsequent synthesis of an antibiotic by the fungus was initiated.

The inhibition and the effect on pigment development of *Fusarium* by *Cephalosporium* was striking when a suspension of *Cephalosporium* conidia in various concentrations was added to agar and mycelial discs of *Fusarium* were placed upon the agar two days later.

Different cultural media for *Cephalosporium* were placed on reciprocating laboratory shakers in either diurnal light or in continuous darkness. Filtrates of media were added to agar, and growth in diameter of *Fusarium* colonies was the method of bioassaying an antibiotic in the filtrate. The diameter of *Fusarium* colonies on agar con-

taining 50 per cent filtrate of *Cephalosporium* growing in a synthetic basal medium was not appreciably retarded. When the basal medium was amended with either cysteine or methionine, *Cephalosporium* filtrate appreciably inhibited growth in diameter of *Fusarium*. In another medium, corn meal-dextrose-peptone broth alone, and in two other media, potato-dextrose and potato-lactose broth amended with methionine, striking differences in the diameter of *Fusarium* colonies resulted when *Cephalosporium* filtrates of these media were added to agar.

Symptoms of *Fusarium* wilt were inhibited when roots of tomato plants were placed in 50 per cent concentrations of *Cephalosporium* filtrate from either the basal medium amended with L cystine or corn meal-lactose-peptone broth for a period of four days before inoculation with *Fusarium*.

Using dry weight as the criterion, *Cephalosporium* grew best in the basal medium when the initial pH was 3.0, at temperatures between 20 and 35°C, when the nitrogen source was yeast extract, and the carbon source was sucrose. When the initial pH of the basal medium was 3.0, 7.2, and 7.4, more mycelial growth of *Cephalosporium* was obtained when it was cultured in diurnal light, while at initial pH values of 5.2 and 9.9 more mycelial growth occurred in continuous dark. When the nitrogen source of the basal medium was NaNO<sub>3</sub> at initial pH 2.6, more mycelial growth occurred in diurnal light; with NH<sub>4</sub>Cl at initial pH 2.7, more growth occurred in continuous dark; and with yeast extract at initial pH 3.0, the fungus grew equally well in light or dark.

In light, *Cephalosporium* mycelium was salmon-orange, while in the dark, the mycelium was gray-white. When gray-white mycelium from the dark was placed in diurnal white, blue, yellow, amber, or red light, the mycelium became orange in all except the red light, where it remained gray-white. If gray-white mycelium from the dark was placed in light, the development of orange pigment was observed within two hours. Conidia of *Cephalosporium* are produced in either continuous light or dark and in diurnal light.

The orange fungus is tentatively placed in the genus *Cephalosporium*, but it may ultimately be placed in the genus *Phialophora*.

Microfilm \$2.50; Xerox \$3.80. 68 pages.

ANATOMY

STUDIES ON EMBRYONIC AND FETAL  
HEMATOPOIESIS WITH SPECIAL  
REFERENCE TO THE GOAT

(L. C. Card No. Mic 60-3550)

Mary Jane Buckman, Ph.D.  
University of Minnesota, 1959

Adviser: R. D. Sundberg, Ph.D., M.D.

Hematopoiesis was studied in a total of fifty-six embryos and fetuses of four different species: goats, pigs, sheep and cattle.

The first hematopoietic organ, the yolk sac, in all of the species studied was found to be the main source of erythrocytes at a time when the main organ systems are developing. The yolk sac in these species produces mainly primitive erythroblasts. However, in all of the species studied the yolk sac was found to produce normoblasts also at about the time that the liver becomes hematopoietic. The presence of cells with morphological characteristics ranging from those of mesenchymal cells to hemoglobin-containing cells confirmed the concept that the erythrocytes in the yolk sac are of mesenchymal origin.

The amount of hematopoiesis seen in the body mesenchyme and connective tissue was minimal. However, the

budding of cells resembling hematopoietic stem cells into the lumen of the dorsal aorta was of such a magnitude in all of the species studied that it suggested the possibility that the dorsal aorta may be an important source of hematopoietic stem cells at one stage of development.

Careful study of serial sections confirmed the probability that normopoiesis in the second main blood-forming organ, the liver, is mainly extravascular (in the spaces of Disse between the hepatic cells and v. Kupffer cells). Developing megakaryocytes and very occasional scattered granulocytes are also seen in the spaces of Disse.

In this study the caprine fetuses were the only animals of sufficient maturity to show splenic or myeloid hematopoiesis. Normoblasts are produced in the fetal spleen of the goat but the amount of splenic erythropoiesis is less than that seen in the liver or bone marrow at the height of their blood production. A few megakaryocytes and granulocytes are also seen in the fetal spleen of the goat.

The initiation of blood cell formation in the bone marrow of the goat is slightly before 70 days intrauterine age. At this time the caprine bone marrow has only a few foci of developing normoblasts and a few granulocytes and megakaryocytes. There is a steady increase in the amount of blood formation in the bone marrow until birth.

A study of the morphology of the primitive erythroblasts formed mainly in the yolk sac led to the conclusion that they are a generation of cells different from the megablasts of pernicious anemia and from the normoblasts of the liver, spleen and bone marrow.

Though the author was unable to distinguish morphologically between the normoblasts produced by the liver and those produced by the bone marrow, certain observations suggested the probability that they are not identical. These include the presence of two different size groups of erythrocytes in sheep at a time when both liver and bone marrow are hematopoietic, the replacement of fetal by adult hemoglobin at a time when the mean cell diameter of the erythrocytes decreases to that found in mature animals and the difference in type of crenation of hepatic and myeloid erythrocytes of the goat.

"Stainable" iron (Prussian blue method) was demonstrated for the first time in primitive erythroblasts. Iron was seen in the primitive erythroblasts of man, goat and pig. Particulate iron was also seen in macrophages in many organs of the embryos including the yolk sac, liver and mesonephros.

Microfilm \$2.50; Xerox \$4.40. 82 pages.

# METABOLIC STUDIES ON THE ISOLATED ISLET TISSUE OF THE PANCREAS OF OPSANUS TAU

(L. C. Card No. Mic 60-3552)

Carl T. Friz, Ph.D.

University of Minnesota, 1959

The cartesian diver respirometer and the Warburg respirometer were used in this study to determine the metabolic activity of toadfish islet and liver slices after the in vitro or in vivo addition of substrates, inhibitors, hormones, and drugs.

It was found that whereas the respiration of toadfish liver slices was not affected by the addition of phosphate ions to the media, the respiration of toadfish islet slices was more than doubled by the addition of phosphate ions. Respiration of the liver slices was increased, however, if both phosphate and zinc ions were added to the media.

Of the substrates used glucose added in vitro or in vivo and pyruvate and isocitrate added in vitro did not affect islet respiration. In contrast to this the in vitro addition of  $\alpha$ -ketoglutarate, glutamate, and succinate stimulated both islet and liver respiration.

Iodoacetate, fluoride, fluoroacetate, malonate, and azide were the inhibitors used in this study, and they inhibited respiration of islet slices from 19 to 58 per cent. When the drugs alloxan (400 mg/Kg) and Orinase<sup>R</sup> (20 mg/100 ml) were added to the media, islet respiration was not altered.

From these results it would appear that respiration of toadfish islet tissue follows the glycolytic scheme and the tricarboxylic acid (TCA) cycle. The failure of glucose, pyruvate, and isocitrate to alter islet respiration does not indicate that the respective enzymes are not present in islet tissue, but suggests that these enzymes are already saturated with these substrates, therefore, additional substrate would not affect islet respiration.

Stimulation of islet respiration by glutamate indicates that toadfish islet tissue contains glutamic dehydrogenase, and this may be significant in synthetic protein reactions.

Microfilm \$2.50; Xerox \$6.00. 125 pages.



## ANTHROPOLOGY

### THE DEEP SONG OF THE ANDALUSIAN GYPSIES: A STUDY OF THE TRANSMISSION AND PERPETUATION OF TRADITIONAL CULTURE THEMES.

(L. C. Card No. Mic 60-3775)

Bertha Beatrice Quintana, Ed.D.  
New York University, 1960

Supervisor: Professor Ethel J. Alpenfels

Based on the hypothesis that Deep Song is an enculturative vehicle through which traditional culture themes of the Andalusian Gypsies are transmitted and perpetuated, the purpose of this study was to establish the relationship of Deep Song to the transmission and perpetuation of traditional themes in Andalusian Gypsy culture. In order to achieve this purpose: (1) the history of the Gypsies in Andalusia was traced from the fifteenth century to the present; (2) the traditional themes the Andalusian Gypsies seek to transmit and perpetuate in their culture were identified; and (3) the origins and perpetuation of Deep Song were studied, and its form, meaning, use, and function identified.

Initial data were obtained from written primary and secondary source materials located both in the United States and Spain. These materials were found to yield the majority of the data needed to trace the history of the Gypsies in Andalusia, to derive a tentative list of traditional themes transmitted and perpetuated by the Gypsies, to trace the origin and perpetuation of Deep Song, and to identify the general musical characteristics of the Deep Song complex.

Ethnographic techniques were employed to validate traditional themes derived from written primary and secondary source materials, and to identify the form, meaning, use, and function of Deep Song. Interviews were conducted in Granada, Seville, Cordoba, Malaga, and Madrid in 1959, with personal observations being made in Cadiz and Jerez de la Frontera in addition to the five cities already named. Thirty Andalusian Gypsies and ten non-Gypsies were interviewed in the field, the latter having been selected on the basis of their having had close, prolonged, and significant contacts with the Gypsies.

The purpose of all validation interviews was to obtain corroboration of the tentative findings pertaining to traditional culture themes, and/or to secure additional data. A total of five traditional themes were identified and validated: (1) Gypsy freedom; (2) ethnic superiority of the Gypsies; (3) Gypsy loyalty and love; (4) Pre-eminence of Gypsy law; and (5) Gypsy fatalism.

Relative to Deep Song, primary data from field interviews and observations served to identify the artifacts used in connection with Deep Song, the nature of the songs, the manner in which it is learned, the purposes for which it is sung, its principal motifs, the ways in which it has changed, and the value placed upon it in the culture.

Walter F. Starkie, who served as consultant to the study, Manuel Centeno, and other Deep Song authorities, participated in this aspect of the investigation.

Six criteria were used as the basis for deriving conclusions relevant to the hypothesis of the study, all of which are implicit in the findings as follows: (1) that traditional culture themes of the Andalusian Gypsies constitute part of the subject matter of Deep Song; (2) that Deep Song is part of the experience of children growing up in Andalusian Gypsy culture; (3) that Deep Song is shared by adult members of the culture; (4) that Deep Song is heard at life crises and at other stress moments; (5) that Deep Song has maintained a characteristic unity even in the face of change; and (6) that Deep Song is regarded by the members of Andalusian Gypsy culture as an integral part of the enculturative process. On the basis of these findings, it was concluded that Deep Song is an enculturative vehicle through which traditional culture themes of the Andalusian Gypsies are transmitted and perpetuated. A general discussion concerning the implications of the findings for the field of education concluded the study.

Microfilm \$3.65; Xerox \$12.85. 282 pages.

### SOME ASPECTS OF THE RELIGIOUS MUSIC OF THE UNITED STATES NEGRO: AN ETHNOMUSICOLOGICAL STUDY WITH SPECIAL EMPHASIS ON THE GOSPEL TRADITION.

(L. C. Card No. Mic 60-4788)

George Robinson Ricks, Ph.D.  
Northwestern University, 1960

Chairman: Professor Melville J. Herskovits

As an ethnomusicological study theoretically oriented to the concepts of cultural dynamics, this dissertation provides insight into the processes by which modification and change occurs within a particular cultural tradition found in a situation of continuous first-hand contact with a dominant culture. In this regard, the Afroamerican field is used as an area of investigation with a view toward throwing some light on the processes through which the United States Negro has retained African musical values and, through the mechanism of reinterpretation, has integrated musical elements from European culture in developing a distinctive musical tradition.

To investigate this long-term creative process a combination of ethnomusicological and ethnohistorical data are utilized. Two major problems are conceived: 1) a definition of the variety of styles found in the religious musical tradition under study, inductively reached through an objective description of musical structure; and 2) the establishment of relationships between these historically

created styles, both in terms of musical structure and the cultural background of exponents of the tradition.

To demonstrate a sequential relationship between successive musical styles in United States Negro religious tradition, a relative dating in time is established. Historical data are employed to establish three periods of religious musical development, and to provide a first-hand description of the style of music in each period. These three are: the Spiritual style, developed in the Early Period (pre-Civil War); the Jubilee style in the Middle Period (post-Civil War); and the Gospel style in the Late Period (about 1900 to date). While these styles are sequential their chronological limits overlap, so that there is no complete dropping off of one style as another appears. Rather, each period is dominated by a particular style.

The relation between these styles is further established through a demonstration of the continuity of cultural background of exponents of the tradition, and through musicological analysis and comparison. In the former case, the continuity of musical values and practices is found to be the function of a kind of cultural conservatism practiced by the large body of United States Negroes whose acculturative experiences have resulted in a slower degree of change from indigenous African patterns and values than among the segment of Negroes whose access to the dominant culture offered greater opportunities for rapid acculturation. A correlation between cultural tradition and socio-economic status is indicated among the culturally conservative elements in the United States Negro population, most obvious in terms of their religious behavior and its concomitant musical tradition. In an urban setting, deeply rooted cultural-patterns of a once predominantly rural Negro group have been reinforced to a large degree by social isolation both from less culturally conservative Negroes and the rest of the community; this is evidenced by the intensification of their traditional religious behavior and musical practices.

Musicological analysis and comparison is carried out in accordance with established procedures of the Laboratory of Comparative Musicology at Northwestern University. Songs selected as representative of each style are subjected to intensive analysis in terms of structural elements: intervals, interval patterns, tempo, melodic level, melodic direction and mode. A statistical summary is used to obtain an objective description of each musical style. Subsequently, the statistical descriptions of each style are compared in order to obtain a clearer definition of musical styles and to determine the degree of retention or change in structural elements among these styles. Detailed transcriptions of songs follow the analysis of each style, which have been performed by representative singers, performances ranging from solos and small group-singing to the renditions of large choirs; examples of instrumental accompaniment are included.

Microfilm \$5.45; Xerox \$19.35. 428 pages.

# THE GRANDSONS OF THE GAUCHOS: A STUDY IN SUBCULTURAL PERSISTENCE.

(L. C. Card No. Mic 60-3146)

Arnold Strickon, Ph.D.  
Columbia University, 1960

This study deals with the criollo subculture, the way of life of the Argentine gaucho of the nineteenth century and the persistence of that way of life among the criollos of modern Buenos Aires Province, Argentina. The traditional subculture is reconstructed on the basis of historical materials. The contemporary picture is based on field work done in a cattle grazing zone in central Buenos Aires Province.

The study first considers the traditional gaucho subculture and the wider economic and political system of which it was a part. The economic and ecological basis of Argentine rural life prior to the late nineteenth century is described. The organization of the estancia, the large cattle ranch, is described. It is shown that the estancia depended on the gaucho as its labor force and how the estancia provided the basic framework to organize huge amounts of land and livestock, and a sparse human population for the commercial production of meat and hides. It is also shown that the owners of the largest estancias came to constitute the national elite.

The study next turns to the gauchos themselves and analyzes their community form, which was the open country neighborhood, their isolation from direct participation in the institutions of the government and of the Catholic Church. It is then shown that only through the estancia owners was the gaucho effected by national trends.

The next stage of the study discusses later technological changes in the livestock industry. Next is discussed the massive immigration from Europe around the turn of the century and the rise of a new "middle class" and urban proletariat. Finally the political and social changes in the structure of the Argentine nation are briefly described and the impact they were supposed to have had on rural Argentina are discussed.

The second part of the study is a description and analysis of the village of Eleodoro Gomez and the countryside around it. It is demonstrated that this zone of the pampas remains "cattle country"; and that the estancia remains the dominant economic institution. The estancia's organization is described and it is shown that in spite of modern technology it is still dependent on men well versed in "gaucho" skills. The specialist trades of the new technology are shown to be in the hands of the new "middle class."

Finally the way of life of the estancia owner, with his wealth and influence in both the city and the countryside, is described and shown to carry forward the pattern of life of the estancia owners of old.

The study then turns to the criollos themselves and describes and analyzes the household, work patterns, the kinship system, and the organization of the neighborhood. It is shown that the community form of the modern criollo, like that of the traditional gaucho, is the open country neighborhood reinforced by a diffuse network of bilaterally extended kindred. The relationship of the criollos to the cities, to the government, and to the Catholic Church is described and analyzed. It is shown that the criollos have few contacts with these institutions other than those



mediated through the institutions of the open country neighborhoods and through the estancias and their owners.

A final chapter deals with the village of Eleodoro Gomez *per se*. It is shown that the village is the "community" of the "middle class" and functions, for the *criollos*, as simply one more among many scattered gathering places in the countryside.

*Criollo* subculture continues to persist in the face of great national and local changes. The structure of *criollo* subculture, like that of the *gaucho*, is characterized by the open country neighborhood, the kindred, direct isolation from national institutions, and political and economic dependence on the landowner. The economic nexus between landowner and *criollo*, as it was between landowner and *gaucho*, is the *estancia* and the *estancia's* dependence upon a mounted and highly skilled labor force.

Microfilm \$5.15; Xerox \$18.25. 401 pages.

#### THE ROLE OF CULTURAL ACCIDENT IN THE DYNAMICS OF CULTURE

(L. C. Card No. Mic 60-4805)

James Herbert Vaughan, Jr., Ph.D.  
Northwestern University, 1960

As an academic concept the term accident comes to us from Aristotelian philosophy; its ontological implications from the *Metaphysics* and its application to logic from the *Topica* and other works of the *Organon*. On the whole contemporary philosophers do not use the term, though Cassirer has taken the position that the accidental as well as the ordered (*Gesetzlichkeit*) must be considered in scientific determinism. In this analysis the term accident is applied not to Being, but to culture, and within this construct we have utilized the most comprehensive of Aristotle's several definitions; accident is that which is not in the essence (*οὐσία*) of a thing--that is, culture. Two corollaries to this definition have been found useful: accident is capable of not being present and accident may be a relative property.

In human societies events have occurred which have been unforeseen or of seemingly chance origin which have nevertheless produced profound changes in the culture of these people; these events have been called historical or cultural accidents by anthropologists. Most interest in such accidents has been sporadic and tangential, however, with the earliest and perhaps most thorough discussion by

Goldenweiser. Following the usage of both anthropologists and philosophers, we have derived the following basic definition: cultural accident is a relatively abrupt, internally nonessential event which from the point of view of the culture affected has an unforeseen and significant effect upon that culture. The study of cultural accident is an approach to understanding the nature of cultural change, first by classifying types of accidents and then by abstracting generic elements from the accidental situation, assessing their importance, and viewing their interplay in varying instances.

Cultural accident cuts across the conventional classification of internally and externally produced cultural change and is consequently divisible into intracultural and intercultural accidents respectively. Other types of accident are derived accidents--accidental consequences of events which may not have been accidental in their inception--and accidents in nature--cultural readjustments to such natural accidents as floods, disease, or less cataclysmic events. Apart from classifying cultural accidents according to their origin, they may be designated according to their over-all effect upon the culture; thus, the additive accident essentially introduces a new element of culture into an existing situation, and an inhibiting accident has the effect of removing or restricting some part of the existing culture. These classifications are illustrated from ethnographic materials with emphasis upon intercultural and intracultural accidents.

Assessing the role of cultural accident in the dynamics of culture is approached through isolating its elements. These elements are then presented as interrelated components of a dynamic situation and any given accident will be the result of the interplay of these elements and the intensity of their manifestation. There are five components of cultural accident; (1) ecological consonance, (2) influence of the recognized innovator, (3) influence of overt opposition, (4) cultural heritage, and (5) perceived advantage or need. There is in addition a factor that pervades the functioning of the components of any phenomenon which is in the field of cultural dynamics; this is the temporal factor, the omnipresent element of *time*. Unlike some scientific studies in which time can be treated as a constant, in the study of cultural accident it becomes a factor affecting each of the components differently and in some cases causing the same situation to appear to be different at different times. The theoretical principles derived in this discussion are applied to a concluding ethnographic example from the Gusii of Kenya.

Microfilm \$2.50; Xerox \$5.60. 114 pages.

## BACTERIOLOGY

### STUDIES ON THE ISOLATION AND METABOLISM OF AVIAN PLEUROPNEUMONIA-LIKE ORGANISMS

(L. C. Card No. Mic 60-4228)

Robert Giles Brackett, Ph.D.  
Rutgers University, 1960

Major Professors: Dr. W. W. Umbreit  
Dr. J. A. Anderson

Several strains of Pleuropneumonia-like organisms were isolated from chickens with symptoms and gross pathology indicative of Chronic Respiratory Disease and Infectious Coryza. These strains were isolated on 1% PPLO Serum Fraction brain heart infusion semisolid medium with penicillin and thallium acetate. None of the strains isolated actively metabolized carbohydrates.

Certain aspects of the metabolism of strain A5969, isolated from a chicken with CRD, were investigated. Cells of this strain were grown at 37 C. in a non-agitated shallow layer of 1% glucose, 1% PPLO Serum Fraction brain heart infusion broth, pH 7.8.

Growing cells of A5969 were able to utilize glucose, mannose, and levulose. Resting cell suspensions were able to oxidize mannose, glucose, glycerol, pyruvate and lactate. Glucose oxidation was inhibited by cyanide, azide, iodoacetic acid, o-phenanthroline, and p-chloromercuribenzoic acid but not by ethylene diaminetetraacetic acid. Glycerol, pyruvate and lactate oxidation was relatively insensitive to cyanide.

Strain A5969 did not appear to have the ability to oxidize fatty acids or sterols.

Cytochrome oxidase and cytochrome respiratory pigments could not be detected in the cells of this strain.

The enzyme catalase was present in the cells of A5969; however, the level was insufficient to allow the oxidation of glycerol to go to completion. This could be achieved by the addition of exogenous catalase.

An active lactic dehydrogenase system and a less active glucose dehydrogenase system was found in strain A5969. The effect of pH on the lactic dehydrogenase system was investigated using methylene blue and 2,3,5 triphenyltetrazolium chloride reduction.

Microfilm \$2.50; Xerox \$4.00. 75 pages.

### CONVERSION OF D-GLUCOSE TO 5-KETO-6-DEOXY-D-ARABOHEXOSE, A COMPONENT OF HYGROMYCIN A, BY STREPTOMYCES HYGROSCOPICUS.

(L. C. Card No. Mic 60-4165)

Alan David Elbein, Ph.D.  
Purdue University, 1960

Major Professors: Henry Koffler and Harold R. Garner

Hygromycin A, an antibiotic produced by *Streptomyces hygroscopicus* and active against Gram-positive and Gram-negative bacteria, has been shown by Mann and Woolf [J. Am. Chem. Soc., 79, 120 (1957)] to contain 5-keto-6-deoxy-D-arabohexose. The conversion of D-glucose to this unusual sugar has been studied with specifically-labeled glucose as the carbon source.

*Streptomyces hygroscopicus* was grown in a synthetic medium composed of glucose and mineral salts for 72 hours, a period after which 300  $\mu$ C of glucose-1-C<sup>14</sup>, glucose-2-C<sup>14</sup> or glucose-6-C<sup>14</sup> was added to the medium and growth allowed to continue for an additional 24 hours. At the end of this time, cells were removed by centrifugation, and the antibiotic was isolated and purified. Since it has not been possible to isolate the 5-keto-6-deoxy-arabohexose as such, it was necessary to reduce the ketone group with NaBH<sub>4</sub>; this was followed by treatment with ethyl mercaptan and HCl. The sugar was isolated as the fucodiethylmercaptal derivative, which was then converted to the free aldehyde by treatment with HgCl<sub>2</sub>. Following purification by paper chromatography, the benzimidazole derivative of the L-fucose was prepared as described by Heath and Roseman [J. Biol. Chem., 230, 511 (1958)].

The benzimidazole derivative was then degraded by treatment with NaIO<sub>4</sub> to give one mole of 2-benzimidazole-aldehyde representing carbon atoms 1 and 2 of the hexose, 2 moles of formic acid representing carbon atoms 3 and 4, and one mole of acetaldehyde from carbon atoms 5 and 6. The 2-benzimidazolealdehyde was removed by filtration after adjustment of the pH to 7.5. The pH was then increased to 8.5-9.0, the acetaldehyde was steam distilled from the solution, and then converted to its dimedon derivative, representing carbon atoms 5 and 6 of the hexose, and iodoform representing carbon atom 6. Hexose carbon atom 5 was recovered in two cases as formic acid and oxidized to CO<sub>2</sub> with mercuric acetate. The residue from the steam distillation was treated with mercuric acetate to oxidize the formic acid to CO<sub>2</sub>.

The 2-benzimidazolealdehyde was oxidized to 2-benzimidazolecarboxylic acid with KMnO<sub>4</sub>. Upon being heated to 190°C, the 2-benzimidazolecarboxylic acid decarboxylates to give CO<sub>2</sub> representing hexose carbon atom 2, and benzimidazole representing hexose carbon atom 1.

The distribution of C<sup>14</sup> in the carbon skeleton of 5-keto-6-deoxy-D-arabohexose arising from glucose-1-C<sup>14</sup>, glucose-2-C<sup>14</sup> and glucose-6-C<sup>14</sup> was determined. When the



organism was grown on glucose-1- $C^{14}$ , 87% of the total activity was found in carbon atom 1 of the 5-keto-6-deoxy-arabohexose, whereas when glucose-2- $C^{14}$  was used 90% of the activity was in carbon atom 2, and when glucose-6- $C^{14}$  was the carbon source, 95% of the activity was found in carbon atom 6. These results are consistent with the idea of a direct conversion of D-glucose to 5-keto-6-deoxy-D-arabohexose without scission or inversion of the carbon chain.

Attempts were made to isolate the 5-keto-6-deoxy-D-arabohexose from hygromycin A. Hydrolysis of the 2,4-dinitrophenylhydrazones of hygromycin yielded a compound which when analyzed (by infrared spectroscopy and C, H, N analysis) appeared to be the 2,4-dinitrophenylhydrazone of the sugar. However, attempts to regenerate the free sugar either benzaldehyde or pyruvic acid were unsuccessful. Acid hydrolysis of hygromycin yielded several spots as revealed by paper and cellulose column chromatography. One of these spots reacted with known sugar sprays. However, enough of this material for further analysis was not obtained.

Microfilm \$2.50; Xerox \$6.20. 129 pages.

#### STUDIES ON THE CELL WALL COMPOSITION OF *PENICILLIUM CHRYSOGENUM*

(L. C. Card No. Mic 60-4169)

John Williams Greenawalt, Ph.D.  
Purdue University, 1960

Major Professors: Henry Koffler and Harold R. Garner

The nature of the cell wall material of *Penicillium chrysogenum* Q176 was investigated by physical and chemical methods. Walls were isolated by sonic oscillation from cells grown at 26 C for 48 hours in synthetic medium. In some cases, 2.0 mg/ml sodium tetraborate was added to the growth medium. Walls isolated from cells grown in the presence of boron are referred to as "borate cell walls"; walls isolated from cells grown in the absence of boron are referred to as "normal cell walls."

The normal cell wall material was found to be composed of 2.38 per cent nitrogen, 2 per cent lipid, 1.26 per cent ash, 60 per cent carbohydrate and 29 per cent chitin (as glucosamine). Thirteen amino acids were detected and quantitated. About 10 per cent of the total nitrogen was contained in these amino acids. Glucose, galactose, mannose and arabinose were present in hydrolysates of the cell wall material in a ratio of 100/30/10/6, respectively.

The borate cell wall material was found to be composed of 1.28 per cent nitrogen, 0.8 per cent ash, 57 per cent carbohydrate and 32.5 per cent chitin (as glucosamine). No lipid determinations were made on these walls. Eleven neutral and acidic amino acids accounted for 6.3 per cent of the total nitrogen of these walls. Analyses for basic amino acids were not made.

Treatment of cell walls with a variety of chemical and physical agents showed the walls to appear fibrous in the electron microscope. Fibers of about 350-1000 Å width appeared to be oriented parallel to the long axis of the cell and seemed to be part of the outer surface of the wall.

Smaller fibers of about 110-120 Å in width were observed to be arranged in a rather loose network and seemed to have no major direction of orientation.

Microfilm \$2.85; Xerox \$9.90. 217 pages.

#### THE NATURE OF THE SLIME OF *MYXOCOCCUS XANTHUS*

(L. C. Card No. Mic 60-4175)

John Gilbert Holt, Ph.D.  
Purdue University, 1960

Major Professor: Dorothy M. Powelson

The present study had two main objectives: determination of the chemical composition of the slime produced by a species of myxobacteria and determination of the changes in the composition of the slime during fruiting body formation. Knowledge of any changes in composition might be of value in understanding the mechanism of fruiting.

First, study of the slime production by *Myxococcus xanthus* in broth culture was undertaken. A strain growing in the dispersed state was isolated from the wild type not producing dispersed growth. A medium containing trypticase (BBL) and salts was used. These studies were carried out in an apparatus in which the broth could be shaken and aerated through a sparger at the same time. Four measurements were made during growth: optical density, pH, polysaccharides in the supernatant by a quantitative Molisch reaction and 260 mμ absorbing material.

Major differences in the growth of *M. xanthus* in liquid culture existed, depending upon the amount of aeration provided. Cultures receiving additional aeration showed greater lysis, more release of 260 mμ absorbing material, and more total polysaccharide produced than those cultures that were not aerated. The final pH of aerated cultures was 8.6, while the final pH of non-aerated cultures was 6.9. Further study showed that slime harvested from broth cultures would not be satisfactory for chemical analyses.

Then, the composition of the slime layer of *M. xanthus* was studied at different times during the fruiting process on solid substrate. The cells were grown on trypticase-salts agar covered with a disk of cellophane and harvested at different time intervals by washing the disk with water. Slime was extracted with cold distilled water and precipitated with 10 volumes of ethanol. The material was purified by repeated reprecipitation from ethanol. The purified material was quantitatively analyzed for protein, lipid, polysaccharide, and nucleic acid. Lipid and protein were determined gravimetrically after ether-ethanol extraction and chloroform-gel removal, respectively. Polysaccharide was determined by the anthrone method and nucleic acid by its absorption at 260 mμ.

It was found that *M. xanthus* produces a heterogeneous slime layer composed of protein, polysaccharide, lipid and nucleic acid. The greater portion of this slime material is produced early in the exponential growth phase. Production then reduces to a slow increase. The amount of slime produced at 18 hours (the end of rapid production) expressed as dry weight of new slime per dry weight of new cells is about six per cent. No evidence for lysis of cells was observed.

Fruiting body formation in these experiments took place between 24 and 32 hours at which time there was also a shift in the percentage composition of the components of the slime. Before fruiting occurred (18 hours) the slime contained about 50 per cent protein, 15 per cent polysaccharide, 25 per cent lipid and 1 per cent nucleic acid. After fruiting was completed (60 hours) the percentages had changed to 28 per cent protein, 10 per cent polysaccharide, 45 per cent lipid and 10 per cent nucleic acid.

The polysaccharide fraction of slime material taken at 18 and 60 hours was analyzed by paper chromatography. The following sugars were tentatively identified in the 18-hour sample: glucose, galactose, mannose, arabinose, ribose, xylose, fucose, rhamnose, glucosamine, galactosamine, glucuronic acid, and galacturonic acid. The 60 hour sample contained the same sugars except the uronic acids. There were also differences in the proportions of the sugars between the two samples. More galactose and xylose was found at 18 hours and more mannose, arabinose, fucose, rhamnose and hexosamine was found at 60 hours.

Microfilm \$2.50; Xerox \$4.20. 80 pages.

#### OBSERVATIONS ON GROWTH AND SPORE FORMATION OF A PUTREFACTIVE ANAEROBE IN SYNTHETIC MEDIA

(L. C. Card No. Mic 60-4239)

Gabriel Joseph Lauro, Ph.D.  
Rutgers University, 1960

Major Professor: C. Olin Ball

This investigation was undertaken for the purpose of determining the growth and sporulation requirements of PA 3679r. Because this strain was isolated at this laboratory, the investigation was initiated by a characterization of the isolate. The organism was found to have the same morphological and biochemical attributes as those published for the parent strain with one significant difference--the organisms ferment mannose.

Sporulation of PA 3679 in the past has been successful only within complex organic media. In cases where a synthetic medium was developed for Clostridia, growth was never luxuriant and sporulation not reported. In this investigation a synthetic medium was developed through two experimental approaches. This medium allowed for growth but no sporulation. Within this medium arginine, thiamin and glucose were essential as their omission suppressed growth. Attempts to cause sporulation in this synthetic medium, through the use of successful published methods, failed. Only trypticase supplementation, of all the nitrogen sources tested, within the synthetic medium, supported sporulation. The stimulatory compound in trypticase was characterized and found to be peptide in nature. Since this stimulatory compound enhanced growth in addition to supporting sporulation, spore synthesis was believed to be only a reflection of an adequate growth medium.

Microfilm \$2.50; Xerox \$6.20. 129 pages.

#### STUDIES ON THE INDUCIBLE MALIC ENZYME

(L. C. Card No. Mic 60-4247)

Helene A. Nathan, Ph.D.  
Rutgers University, 1960

Major Professor: Dr. W. W. Umbreit

The malic enzyme catalyzes the reaction  $L\text{-malate} \leftrightarrow \text{pyruvate} + \text{CO}_2$ . Several workers have suggested that the same enzyme catalyzes the reaction:  $\text{oxalacetate} \rightarrow \text{pyruvate} + \text{CO}_2$ .

The malic enzyme of all organisms, save the three studied here, are constitutive. For these three bacteria, *Lactobacillus plantarum*, *L. casei*, and *Streptococcus faecalis*, the malic enzyme is inducible.

The inducible nature of the bacterial enzyme, the availability of defined media for the growth of the microorganisms, and the ease with which both synthesis of the enzyme and final enzyme concentration may be estimated, suggested the use of the inducible malic enzyme for further study.

The presence and inducible nature of the malic enzyme in *L. casei* and *S. faecalis* were first demonstrated in this thesis.

With *L. plantarum*, the effect of graded amounts of the natural inducer-substrate, L-malate, was studied. When enzyme was synthesized by cell suspensions, the inducer and building blocks for protein synthesis had to be added simultaneously in order to insure that the amino acids which were supplied would be used for the synthesis of the induced rather than constitutive protein. If addition of inducer was delayed until after the initial supply of amino acids was exhausted, only the addition of a fresh supply of amino acids at the time of addition of inducer could insure that the inducible malic enzyme would be synthesized.

A manometric method was tried in which both induction and assay of the malic enzyme were done in one closed system. This method had to be discarded since at least one potential inducer,  $\alpha$ -ketoglutarate, inhibited the utilization of the natural inducer-substrate, L-malate.

Induction could be accomplished during growth of the organism. Then only assay of any enzyme-protein induced was done manometrically. This method allowed removal of any unassimilated potential inducer and prevented interference with the assay by unused potential inducer.

Choice of level of potential to add to the growth medium was based on the amount of natural inducer, L-malate, required to saturate the enzyme synthesizing system. Saturation was said to be achieved when suspensions of the "pre-induced" cells: 1. synthesized no more enzyme even when supplied with protein building blocks (sth slope of the curve did not change), 2. there was only a trivial amount of inhibition upon addition of chloramphenicol (an inhibitor of protein synthesis) to cell suspensions supplied with protein building blocks.

Of 29 compounds surveyed, only L-malate, the natural inducer, stimulated considerable malic enzyme synthesis.

There is no positive evidence for the frequently suggested bifunctional system in the malic enzyme. It had been suggested that both the ability to decarboxylate malate and oxalacetate to form pyruvate reside on the same protein. We showed that oxalacetate could induce synthesis of oxalacetate decarboxylase but not malic enzyme. The oxalacetate system is composed of two parts,



the decarboxylase and a permease. An  $\alpha$ -keto group is required for induction of the permease: L-malate could induce only oxalacetate decarboxylase but not the permease. Oxalacetate, acetoacetate, and  $\alpha$ -ketoglutarate could induce both decarboxylase and permease.

The *S. faecalis* malic enzyme behaves as does the *L. plantarum* enzyme with respect to cofactor requirements, specificity of inducers and oxalacetate decarboxylase system.

The so-called unique effect of biotin deficiency on the reduction of synthesis of malic enzyme by cell suspensions of the deficient organisms is also shared by cells deficient in niacin, thiamine, and B<sub>6</sub>. In experiments with niacin, or thiamine, or B<sub>6</sub> or biotin-deficient cells, addition of the particular deficient vitamin resulted in stimulation of synthesis of malic enzyme. Synthesis of malic enzyme by riboflavin-deficient cells was not stimulated by the addition of riboflavin. Pantothenate deficiency resulted in either a small reduction or a small stimulation of malic enzyme synthesis.

A deficiency of p-aminobenzoic acid (PAB) caused by the simple omission of PAB from the growth medium caused two effects: 1. an increase in the synthesis of malic enzyme and 2. a characteristic pattern of inhibition (when the inhibitors are chloramphenicol and chlorpromazine [CPZ]).

If the growth medium which lacks PAB is supplemented with methionine and thymidine, the amount of malic enzyme synthesized (and inhibition pattern) follows the normal rather than the PAB-deficient pattern.

As the metabolism of adenine and PAB and adenine are closely connected, cells deficient in adenine were also tested for ability to synthesize malic enzyme. Adenine-deficient cells follow the PAB-deficient pattern but may be transposed to the normal pattern if adenine is added at the time of malic enzyme synthesis (in the Warburg).

Microfilm \$2.50; Xerox \$5.20. 103 pages.

#### THE STUDY OF *SPHAEROTILUS* UNDER SIMULATED STREAM CONDITIONS

(L. C. Card No. Mic 60-4249)

Robert Arthur Phillips, Ph.D.  
Rutgers University, 1960

Major Professor: Dr. Hovhaness Heukelekian

Several factors influencing the growth of the sheathed, filamentous bacterium, *Sphaerotilus*, were studied in the laboratory under simulated stream conditions. These factors were: (a) the concentration of the carbon source, glucose; (b) the concentration of the nitrogen supply; (c) the BOD:N:P ratio; and (d) the velocity of the flow in the channels.

A set of artificial channels was constructed and a reproducible method was developed to determine the amount of *Sphaerotilus* adhering to submerged glass slides in response to controlled conditions.

Glucose and NH<sub>3</sub>-N were used throughout the study and produced, in general, good *Sphaerotilus* growth. Other

organisms were present in the slime to various degrees even when channels were inoculated with pure culture.

A laboratory-cultured strain of *Sphaerotilus* produced the same quantity of growth at total nitrogen concentrations of 0.9 to 4.6 mg/l, when the glucose concentration was 10 mg/l. At less than 0.9 mg/l total nitrogen (equivalent to a BOD:N:P ratio of 100:15:1 with 10 mg/l glucose), *Sphaerotilus* was no longer dominant, but was replaced by zoogaea.

Channels inoculated with fresh stream slimes containing *Sphaerotilus* produced, at 10 mg/l glucose, equal amounts of growth at total-N concentration of 0.5 to 0.8 mg/l. With an increase in glucose concentration to 20 mg/l, growth was doubled when the total-N concentrations were 0.65 and 0.8 mg/l. For 20 mg/l glucose and 0.65 mg/l total-N, the BOD:N:P ratio was 100:5:1. With only 0.5 mg/l total-N, the growth was 30 per cent less than that at 0.65 and 0.8 mg/l total-N.

Growth was directly proportional to glucose concentration at 5 to 20 mg/l glucose. At 40 mg/l, the *Sphaerotilus*, which was initially dominant, was overgrown by zoogaea and total growth was less than that expected if the response had been proportional to the concentration of nutrients.

The principal effect of flow velocity was on the character of the attached growth. At a velocity of 0.15 fps (4.5 cm/sec.), the growth was composed of a mixed flora of *Sphaerotilus*, zoogaea, and other forms. At velocities of 0.3 and 0.6 fps (9 and 18 cm/sec., respectively), the amounts of contaminants decreased until at the highest velocity, only *Sphaerotilus* was evident.

Microfilm \$2.50; Xerox \$5.00. 98 pages.

#### STUDIES ON STREPTOLYSIN S: ITS PRODUCTION, EFFECT ON CELLS IN VITRO AND ROLE IN ALTERING HOST RESPONSE.

(L. C. Card No. Mic 60-4339)

Irvin Stanley Snyder, Ph.D.  
University of Kansas, 1960

The role of streptolysin S and many other extracellular products of  $\beta$  hemolytic streptococci in streptococcal infections is unknown. This study was initiated to determine the effects of one of these products, streptolysin S, on a variety of systems.

Streptolysin S was observed in this study to be produced by streptococci of Lancefield groups A, C and G. Group A streptococci produced considerably more streptolysin S than groups C or G. Group C human strains produced more streptolysin S than animal strains of group C. The influence of mouse passage on streptolysin S formation by streptococci of groups A, C and G was studied. Streptococci of group A with one exception elaborated more streptolysin S after ten animal passages than they did previously. Non-hemolytic streptococci of group D did not produce streptolysin S before or after animal passage.

A study of the effect of this toxin on leukocytes revealed that streptolysin S was neither leukolytic nor

leukotoxic. Four lines of cells grown in tissue culture showed different sensitivities to streptolysin S. Cardiac tissue culture cells (Giardi) and McCoy cells of synovial origin were exhibited by lower concentrations of streptolysin S than were HeLa cells and KB cells. The oxidation of glucose by heart, spleen and kidney tissue slices was not affected by streptolysin S. The contractility of perfused rabbit and frog heart and isolated rabbit auricle was not impaired by streptolysin S.

The influence of serum from various species of animals on streptolysin S production was investigated. Horse and dog serum stimulated the production of large amounts of streptolysin S. Guinea pig and rabbit serum stimulated the formation of only small amounts of the toxin. Serum from man and monkey was intermediate with respect to stimulation of streptolysin S production.

The antigenicity of streptolysin S was reinvestigated. Attempts to produce an antistreptolysin S in rabbits and guinea pigs were made by inoculation of the toxin emulsified with Freund's adjuvant or adsorbed to kaolin particles. Precipitating antibody and antibody which neutralized the hemolytic activity of streptolysin S was not detected. Complement-fixing and agglutinating antibody employing, as the antigen, toxin adsorbed to streptolysin S also was not found. However, sera from animals inoculated with streptolysin S adsorbed to kaolin particles agglutinated unadsorbed kaolin particles, while sera from control animals inoculated with unadsorbed kaolin particles did not agglutinate kaoline particles. The kaolin agglutinating factor was found in the gamma-1 fraction of serum. Kaolin agglutinins were observed in immune sera prepared in rabbits to dog serum and to some bacteria and viruses but not in human sera from patients in the acute and convalescent stage of rheumatic fever.

Attempts to produce antibody with rabbit heart tissue altered by incubation with streptolysin S were carried out. Precipitating and complement-fixing antibody to altered and normal heart tissue was not detected.

Streptolysin S was slightly pyrogenic upon inoculation into rabbits.

Preliminary experiments indicate that streptolysin S may alter the host response of rabbits to inoculation of *Salmonella typhosa* endotoxin.

These experiments reveal several effects of streptolysin S and indicate that this toxin needs to be considered in attempting to elucidate the pathogenesis of streptococcal infections. Microfilm \$2.50; Xerox \$6.80. 145 pages.

# STUDIES ON THE INFLUENCE OF BIOTIN RESTRICTION UPON THE PHYSIOLOGY OF YEAST

(L. C. Card No. Mic 60-4269)

Jo Anne Mary Whitaker, Ph.D.  
Rutgers University, 1960

Major Professor: Wayne W. Umbreit

The intracellular pink pigment and the ultra-violet absorbing substance which accumulated, when *Saccharomyces cerevisiae* 139 cells were grown in Snell's medium without added biotin, were detected and studied. The pink pigment, which became more profound with longer incubation time, gave absorption peaks in the visible range at 480 m $\mu$  and 530 m $\mu$ , and the ultra-violet absorbing substance gave a maximum peak at 255-260 m $\mu$ . The amount of the ultra-violet absorbing substance, which accumulated, was reduced approximately 50% by the addition of biotin to the medium and reduced 75% by aspartic acid addition. This would seem to indicate that aspartic acid either prevents its formation or promotes its utilization. Biotin may function by providing aspartic acid. The ultra-violet absorbing substance was not identified, but the absorption spectrum suggests that it may be a purine, pyrimidine or an intermediate in purine, pyrimidine, or nucleotide synthesis. It was observed that cells grown in defined medium, supplemented with aspartic acid, tended to agglutinate and adhere to glass when centrifuged, making resuspension difficult. Capsules and protoplasts were ruled out as possible explanations.

A linear relationship between biotin content of cells and  $P^{32} = \text{ATP}$  exchange was indicated. The addition of 5% carbon dioxide decreased the  $P^{32} = \text{ATP}$  exchange.

The growth-inhibitory effect of aminopterin was shown to be dependent upon the presence of biotin or aspartic acid in the medium. Both yeast extract, and a mixture of adenine, guanine, thymine and uracil, of which adenine and thymine seemed to account for most of the activity, reversed this inhibition. This suggests that aspartic acid, and biotin probably through aspartic acid synthesis, are involved in purine-pyrimidine synthesis. However, the purines and pyrimidines were not capable of completely replacing biotin, aspartic acid or yeast extract for optimal growth, thereby suggesting the involvement of aspartic acid in a function which is not entirely replaced by purines and pyrimidines. Microfilm \$2.50; Xerox \$5.00. 96 pages.

## BIOGRAPHY

### VICTOR L. BERGER, A BIOGRAPHY.

(L. C. Card No. Mic 60-4782)

Edward John Muzik, Ph.D.  
Northwestern University, 1960

Victor L. Berger, socialist politician, newspaper editor, and labor leader, was born in Austria-Hungary in 1860 and

received a fine education including some university training. He came to Milwaukee in 1881 as a teacher three years after migrating to America. Through his first newspaper, the *Vorwaerts*, he cooperated with the Populists from 1893 to 1896. In 1901 in conjunction with Eugene V. Debs, whom he helped convert to socialism, and Morris Hillquit, Berger established the Socialist Party of America. For most of his life he served on its national executive



committee although he was expelled from this position in 1905 by those who disagreed with his philosophy of evolutionary socialism.

Beginning in 1898 the Milwaukee Social-Democratic Party, under Berger's leadership, participated in municipal and state elections. By 1904, aided by exposures of extensive corruption, he led the party to second rank in Milwaukee; in 1910 the Social-Democrats were finally successful in winning temporary control of this city.

Berger was active in the Milwaukee Federated Trades Council (FTC), the Wisconsin State Federation of Labor, and the American Federation of Labor (A.F.L.). Through his efforts the socialists gained control of the FTC in 1899-1900 and remained a power in labor circles in Wisconsin for many years. Berger's major contribution on the national level was in persuading the A.F.L. to adopt his proposal for an old-age pension in 1908.

As America's first socialist congressman in 1911-1913, he played an active role in the Lawrence, Massachusetts, strike of 1912 and in removing a federal judge from office. In addition he advocated humanitarian legislation and presented socialist proposals for government ownership of large-scale industries. He was defeated in 1912 by a coalition of the two major parties.

Berger's other newspapers, particularly the Social-Democratic Herald and the Milwaukee Leader, constituted a medium through which he spread his Social-Democratic philosophy throughout the United States. During World War I the loss of the Leader's second class mailing privilege precipitated a hard-fought but unsuccessful battle with the federal government. Strongly opposed to the war, Berger received over 110,000 votes in a losing race for the United States Senate in 1918. Victorious in a bid for

the House in November 1918, Congressman-elect Berger was convicted of disloyalty in January 1919 in a United States Federal District Court and sentenced to a twenty-year prison term. Twice excluded from Congress in November 1919 and January 1920, Berger was finally seated in 1923 after the supreme court overthrew his conviction on a technicality.

Prior to his exclusion Berger was instrumental in preventing Communist conquest of the party as this radical group whose tenets he abhorred was expelled in 1919. Earlier Berger's efforts had been decisive in removing the I.W.W. element for advocating sabotage.

In his final years in Congress, 1923-1929, Berger presented measures similar to those of his first term but took a greater interest in foreign affairs and civil liberties. These new concerns resulted from his wartime experiences and his post-war activities which included a European tour where he sympathetically viewed Germany's troubles.

Defeated for re-election in 1928, Berger returned to Milwaukee where his plans to relinquish the Leader were interrupted by a streetcar accident which resulted in his death on August 7, 1929. Although Berger was irascible, egocentric, and overly-aggressive, his strong character and political sagacity enabled the socialists to control Milwaukee for many years; his influence yet remains in that community's social and civic conscience which was first aroused by his efforts.

Major sources used include the Berger Papers at the Milwaukee County Historical Museum, the Socialist Party Papers at Duke University, the Hillquit and other papers at the Wisconsin State Historical Society, government documents, and numerous newspapers.

Microfilm \$6.20; Xerox \$22.05. 486 pages.

## BIOLOGY - GENETICS

### THE BREEDING BEHAVIOR AND INTERRELATIONSHIPS OF SOME POD AND SEED TRAITS OF PEANUTS

(L. C. Card No. Mic 60-3718)

Richard Lawson Bernard, Ph.D.  
North Carolina State College, 1960

Supervisor: Walton Carlyle Gregory

A study was undertaken to investigate the breeding potentialities of several quantitative traits in peanuts. Data were taken on the hybrid populations and progenies of four crosses between eight diverse varieties in the  $F_1$  through  $F_4$  generations grown in 1945 to 1949 and of fifteen crosses between six  $F_4$  selections in the  $F_1$  through  $F_4$  generations grown in 1950 to 1953. Replicated tests were grown each year and data were taken on the following ten traits: seed yield per plot, number of pods per plot, percentage of immature seeds, percentage of three-segmented pods, percentage of two-segmented pods, number of seeds per hundred segments, weight per seed, percentage of diseased

Pods, weight of shells per plot or shelling percentage, and leaf spot score.

Variations among crosses and among progenies within crosses were measured in terms of genetic and environmental variance and covariance components. These estimates were used in computing heritability quotients and estimates of potential genetic advance for each trait, in calculating correlation coefficients between pairs of traits, and in devising selection indexes using various combinations of these traits.

Of the ten traits investigated, all appeared to have sufficient genetic variability for appreciable changes to be possible through selection. All traits except the percentage of three- and two-segmented pods showed some relationship with yield. Of these, the percentage of immature seed, the weight per seed, the shelling percentage and the leaf spot score were more heritable than yield. Based on estimates of genetic and environmental variances and covariances, selection for individual traits would result in substantial increases in predicted yield advance in many instances, but selection for an index including yield and any or all of the other traits did not improve over

selection for yield alone. Percentage of immature seeds, shelling percentage, and leaf spot score appear to be of practical value in lieu of yield testing, while weight per seed and percentage of diseased pods may deserve some further consideration.

Microfilm \$2.50; Xerox \$5.40. 106 pages.

THE EFFECTS OF X-IRRADIATION ON THE  
DISTRIBUTION OF RADIO-IODINATED  
HUMAN SERUM ALBUMIN IN THE GOLDEN  
HAMSTER (*Mesocricetus auratus*)

(L. C. Card No. Mic 60-3439)

Arthur Bernard Callahan, Ph.D.  
Boston University Graduate School, 1960

Major Professor: George P. Fulton

The fact that ionizing radiation acts as a non-specific vascular damaging agent which increases the fragility and "permeability" of blood vessels has been well established in the literature. However, the relationship between dosage and "permeability" has not been definitely established either in the total animal or in the individual tissues.

The purpose of this study was to determine the effect of sub-lethal and supra-lethal doses of ionizing radiation in transvascular exchange. In order to accomplish this, the rate of disappearance of injected radio-iodinated human serum albumin from the circulation of non-irradiated hamsters was compared with that of hamsters irradiated at 600 r and 1200 r irradiation exposures. Further, the rate of disappearance from the plasma as a whole was determined as well as the rate for liver, spleen, kidney, lung, adrenal and intestine in order to determine if the effects on transvascular exchanges due to irradiation injury were more pronounced in any particular tissue. Determinations were also made of the times required for vascular-extravascular equilibration of injected radio-albumin and the intravascular and extravascular albumin masses in the various tissues of the non-irradiated and irradiated groups in order to correlate the disappearance rates with changes in vascular-extravascular albumin mass.

The disappearance of radio-albumin from the circulation of the 600 r irradiated group proceeded at a rate which was approximately twice that of the non-irradiated group. The plasma disappearance for the 1200 r group was only slightly faster than for the non-irradiated group. The rate of extra-vascular accumulation of radio-albumin in the individual organs of non-irradiated animals exhibited considerable variability. The disappearance rates in the intestine, adrenal and liver were faster than the total body rate, and the rates for spleen, kidney and lung were slower.

Exposure to ionizing radiation produced differential alterations in the disappearance rates of the individual tissues as compared with the controls. The rates in adrenal, liver and lung at 600 r were slower than in the controls, and the rates in spleen, kidney and intestines were faster. At 1200 r, the disappearance rates were faster for all tissues examined except the liver.

The intravascular and extravascular albumin masses also differed for the individual tissues in the non-irradiated group. Exposure to ionizing radiation produced significant

changes in the extravascular albumin masses in the various tissues. The extravascular albumin mass of the adrenal showed a progressive increase with increasing x-ray exposure. All other tissues of the 600 r group showed significantly increased extravascular albumin masses while those of the 1200 r group were significantly decreased.

The results obtained for the 600 r and 1200 r irradiated hamsters indicate that the animals in these two groups are in totally different physiological states. The 600 r group represents a sub-acute phase of the radiation syndrome in which recovery from vascular damage, manifested by loss of plasma protein into the extravascular spaces, has not yet occurred. The 1200 r group, on the other hand, has received much greater vascular damage and is in a far more acute stage of the radiation syndrome. The rapidity and magnitude of the plasma protein loss from the vascular system in the 1200 r group has resulted in a more rapid and more pronounced response of the homeostatic mechanism. This response manifests itself in the compensatory shift of extravascular protein into the intravascular compartment in order to maintain the levels of blood volume and total circulating plasma protein.

Although the consideration of the function of the homeostatic compensatory mechanism explains the plasma-lymph ratio, equilibrium time and disappearance rates for the total body plasma, the differential values obtained for the various tissues are not completely clarified. The total body plasma reflects the over-all result of the irradiation response of the individual tissues of the body. The effects produced on the tissues by ionizing radiation may be direct, for example poisoning of the cells by ionization by-products, or they may be indirect. The indirect effects on a particular organ or tissue may result from irradiation effects on a hormone or enzyme system in an entirely different organ such as the adrenal. Such indirect effects could very well upset the homeostatic mechanism of an individual organ and either potentiate or inhibit the direct effect of irradiation. Therefore, in addition to kinetic considerations, the results obtained in the individual tissues must be considered in light of additional irradiation effects. These effects include hemoconcentration, dehydration, extravasation of red cells into the lymphatic system as well as apparently increased permeability due to local anoxia and increased hydrostatic pressure. Furthermore, differential disappearance rates of the various tissues may also reflect morphological differences in capillary endothelium as described by electron microscopists which may influence the effect of irradiation injury on transcapillary exchange.

Microfilm \$2.50; Xerox \$6.40. 132 pages.

RADIO-SENSITIZING EFFECT OF THYMIDINE  
ANALOGS ON HUMAN CELL LINES

(L. C. Card No. Mic 60-4229)

Bozidar Djordjevic, Ph.D.  
Rutgers University, 1960

Major Professor: Dr. Wacław Szybalski

Methods were developed for quantitative studies of the human cell line D98S, originally derived from sternal bone marrow. In the early phase of the study, inhibitory effects



of a large series of toxic drugs were evaluated, for the purpose of selecting drug-resistant cell lines. Subsequently, the newly discovered radiosensitizing effect of 5-bromodeoxyuridine (BUDR) was studied and its mechanism investigated.

D98S cells can be cultivated indefinitely in the presence of BUDR at concentrations up to 10  $\mu\text{g}$  per ml, and for a limited period of time in the presence of 5-iododeoxyuridine (IUDR). Glass-attached cells multiply at an undiminished rate for approximately one generation after the addition of BUDR; later the division rate decreases. Cells cultivated in the presence of BUDR during several cycles of growth have a division rate almost identical to that of untreated cells, giving rise to a BUDR-resistant strain. During incubation, BUDR is incorporated into cell DNA, replacing thymidine; this may be enhanced by simultaneous presence of 5-fluorodeoxyuridine, a thymidylate synthetase inhibitor. Substitution of thymidine by BUDR results in an increase of the specific density of DNA, as revealed by density gradient centrifugation, and renders the cells highly sensitive to ultraviolet and X-ray irradiation.

The density of DNA from normal cells is 1.703  $\text{g}/\text{cm}^3$ , while DNA from cells grown for many generations in the presence of BUDR acquires a density of 1.734  $\text{g}/\text{cm}^3$ . The latter cells, grown for one generation without the analog, yield a "semi-heavy" DNA, with an intermediate density of 1.724  $\text{g}/\text{cm}^3$ . Two cell divisions on BUDR-free medium yield both normal (light) and semi-heavy DNA. These results and those obtained with DNA from normal cells grown for various periods of time in the presence of BUDR, suggest that the mode of DNA replication in human cell lines is of a semi-conservative nature.

The degree of radiosensitization depends on whether DNA has been BUDR-labelled in one strand only (unifilarly), or in both strands (bifilarly), and on the distribution of both types of DNA in the cell.

Cultivation with IUDR has a similar radiosensitizing effect, but has also a much more pronounced inhibitory effect on cell division.

Functional DNA, as judged by radiosensitization with BUDR, is produced during partial protein inhibition by chloramphenicol.

Microfilm \$2.50; Xerox \$5.40. 109 pages.

#### ARTIFICIAL INDUCTION OF POLYPLOIDY IN ORCHIDS BY THE USE OF COLCHICINE

(L. C. Card No. Mic 60-4660)

Henry Yoshiki Nakasone, Ph.D.  
University of Hawaii, 1960

The value of polyploidy is well recognized in fundamental biology and in applied agriculture. In orchid breeding a high degree of sterility among intergeneric hybrids and to a lesser degree among interspecific hybrids was encountered. To overcome this sterility barrier, work was initiated to find methods of doubling the chromosome numbers and to study the behavior and the characteristics of the induced polyploids.

Seeds and vegetative sections of *Vanda* and *Dendrobium* species and hybrids were treated in various ways. Seeds

were either soaked in colchicine solutions and sowed in nutrient agar or planted directly in colchicine-incorporated nutrient agar. Seedlings were soaked in aqueous colchicine. Cuttings and shoots were treated by immersing the basal ends in aqueous-colchicine. Lanolin and glycerine-colchicine were applied to incised apical regions.

When the results were evaluated, it was found that tetraploidy was induced only in cuttings and young shoots of *V. Miss Joaquim*, whose basal ends were immersed in aqueous-colchicine. Effective concentrations were between 0.5 and 1.5 percent and duration of exposure was between 2 and 6 days.

Among the ten tetraploids induced, only one gave 4x counts consistently at all nodes, while the others gave variable counts of 4x and 2x in the same roots or in different roots of the same plant, indicating chimeral and mixoploid nature of these induced polyploids.

Anatomical sections of a shoot apex from a plant known to give 4x-2x counts showed distinctly that cells in the tunica layer on one side were visibly larger than those on the opposite side, indicating that doubling was not complete. In *V. Miss Joaquim* shoot apex there appears to be two layers of tunica and a group of cell initials composing the corpus region. This would mean that complete tetraploidy could be obtained only if all the cell initials were affected. If a few cells remained diploid, a mixoploid condition would arise. If cell initials giving rise to tissues on one specific sector of the stem were affected, sectorial chimeras would result. These two conditions seem to have occurred in the tetraploids induced in these experiments.

Size of the cells in the apex of the tetraploids was visibly larger than those in the diploid shoot apex. Stomatal counts showed no differences in number between diploid and tetraploid leaves. However, the stomata of induced tetraploids were found to be significantly larger than those of the diploid plants.

Microfilm \$2.50; Xerox \$5.00. 96 pages.

#### THEORETICAL ANALYSES OF DOUBLE-CROSS AND THREE-WAY HYBRID POPULATIONS

(L. C. Card No. Mic 60-3729)

John Oren Rawlings, Ph.D.  
North Carolina State College, 1960

Supervisors: Columbus Clark Cockerham and  
Donald Loraine Thompson

The purposes of this dissertation are to develop the analyses of variance for double-cross hybrids and three-way hybrids and to determine the genetic information available from such analyses. The analyses of variance are presented for the complete set of double-cross hybrids and for the complete set of three-way hybrids from a set of  $p$  lines. The  $p$  lines are assumed to be a random sample of lines with arbitrary but equal inbreeding derived from a random mating population.

The sum of squares due to hybrids is partitioned into an orthogonal set of seven sums of squares in both the analysis of double-cross hybrids and the analysis of three-way hybrids. The expectations of the mean squares are derived

in terms of covariances between hybrid relatives and in terms of the effects defined in a model of linear effects for each analysis. The functional relationships between the components of variance and the covariances between relatives are established. Genetic expectations for the components of variance are derived in terms of the components of genetic variance from the genetic expectations of the covariances between hybrid relatives.

The genetic interpretations of the F-tests of the components of variance are presented. Several F-tests are presented in each analysis which provide information relative to various genetic hypotheses, many of which involve only epistatic components of genetic variance. F-tests are available for testing additive genetic variance plus all-additive types of epistasis and for testing dominance variance plus all components of epistatic variance except the all-additive types. Relatively powerful tests are presented for testing dominance variance plus all components of epistatic variance and for testing all components of epistatic variance except the all-additive types in both analyses.

Quantitative estimates of additive variance, dominance variance, the three dual-factor epistatic components and the three-factor additive x additive x additive component of epistatic variance are available from either analysis. The estimators for these components of genetic variance are presented for the analysis of double-cross hybrids and the analysis of three-way hybrids and the method of deriving their variances is indicated.

It is concluded that either the analysis of double-cross hybrids or the analysis of three-way hybrids will provide considerable information concerning gene action concomitant with the evaluation of potential hybrids.

Microfilm \$2.50; Xerox \$4.80. 92 pages.

#### STUDIES ON THE PATHOGENESIS OF VIRUS INDUCED ROUS SARCOMA IN CHICKS AND TURKEYS

(L. C. Card No. Mic 60-4263)

Herbert Jennings Spencer, Ph.D.  
Rutgers University, 1960

Major Professor: Dr. Vincent Groupé

These studies were designed to obtain basic information concerning the initiation and development of Rous sarcoma in newly-hatched chicks and turkey poults.

Preliminary experiments were carried out to survey the distribution of tumor foci and the associated viral titers in infected birds. These experiments involved young chicks and turkey poults, two routes of inoculation, and three strains of Rous sarcoma virus (RSV). The results may be summarized as follows:

- 1) Secondary tumors occurred most frequently in the lungs, liver, and spleen of the infected animals.
- 2) Whenever tumors were found, that tissue always exhibited high viral titers.
- 3) Appreciable viral titers were often found in tissues in which no malignancy was apparent, either grossly or in single random sections.

4) In the brain, pathological changes and high viral titers were found only following intracerebral inoculation. After subcutaneous infections, the brains were negative.

5) In chicks, the tumor was of a myxosarcomatous structure, which was characteristic of both the primary tumor and of secondary foci in most of the effected organs.

In turkeys, the tumor appeared as a dense spindle cell sarcoma, which again was common to both the primary and metastatic tumors.

A time study was made of tumor pathogenesis and the development of viral titers in the brain, lungs, and blood of chicks following intracerebral inoculation with RSV. The results indicated that virus was detectable in the brain by day 2 and in the lung by day 3, with the titers rising sharply to 7 logs by the 8th and 9th days respectively. The blood plasma contained infective virus on day 6, and levels rose to a maximum of 3.5 logs on the 10th day.

Hyperplastic changes occurred in both the brain and the lungs at the same time that virus was first detectable in these tissues (days 2 and 3 respectively). In the brain, these alterations were first found in the pial-arachnoid membrane. By the 4th day, aberrant cell types were also found in the margins of the cerebral ventricles. Subsequently, frank malignancy developed both in the subarachnoid space and in the periventricular areas. Both in the brain and in the lungs, the development of malignancy appeared to result from progressive *in situ* changes, rather than as the result of cellular metastasis.

A similar time study was carried out in chicks following subcutaneous inoculation. The development of malignancy in the lung was the same as previously described, i.e., a progressive *in situ* change in the interstitial connective tissue elements. The virus levels in the primary tumor remained essentially constant. Levels in the plasma were virtually the same as those following intracerebral inoculation.

The final series of studies was concerned with the infectivity of various blood components. It was found that on a weight basis, the buffy coat contained over 99% of the virus activity in the blood. A daily time study of infective levels in the plasma, buffy coat, and sternal bone marrow indicated that the buffy coat and sternal marrow became infective on the 4th or 5th day, attained titers of 6 logs of virus. In the blood plasma, virus did not appear until the 6th day after infection, and the maximal titers were under 4 logs.

These findings have been interpreted and discussed with respect to previous studies.

Microfilm \$2.50; Xerox \$7.20. 155 pages.

#### SELECTION FOR BLOOD-pH IN THE HOUSE MOUSE

(L. C. Card No. Mic 60-4341)

Herbert Glenn Wolfe, Ph.D.  
University of Kansas, 1960

High and low blood-pH lines of mice have been established by selection. Selection was based on individual merit, and minimal inbreeding was practiced for five



generations until it became evident that no further progress was possible. Brother-sister matings were then initiated, and selection was continued for two additional generations. The experiment was in part a replication of an earlier two-way selection experiment from the same heterogeneous foundation stock. The foundation stock was maintained contemporaneously to selected lines as a control. The new lines are designated TH (high) and TL (low), whereas those from the earlier experiment are known as pHH (high) and pHL (low).

Response was immediate. Maximum divergence between TH and TL lines was .069 pH units and was attained in the fourth generation. The rapid response and early limits to selection indicate that genetic control is by a few additive loci, possibly two. Response did not diminish as the plateau was approached.

Selection differentials were greater in the TL line, but response in TH and TL lines was equal judged by their divergence from the control line. The asymmetry is believed to be due to errors in classification of type of blood (arterial versus venous) in choosing parents for mating in the low line and not to any real differential response.

Realized heritability was 16 percent for TH and TL lines combined, compared to an estimate of 14.5 percent based on intraclass correlations between full-sibs of the control line. Confidence limits at the 95 percent level for the latter were 4.8 percent to 24.2 percent. Estimates are biased in the minus direction because of some inbreeding in the foundation stock at the beginning of selection. Maternal effects on blood-pH appear to be absent or negligible. There is some indication of dominance and epistasis from the discrepancy between variance due to dams

and variance due to sires, but differences are within sampling error.

Gene action is additive on a logarithmic scale. Blood-pH means from  $F_1$ ,  $F_2$ , and backcrosses were equal to midparent within sampling error and there is no evidence for directional dominance or overdominance either from crosses or the nature of the selection response. Crosses of TH and TL with pHH and pHL (inter-selection crosses) gave blood-pH means midway between contemporary parental lines.

A basic difference between the two selection experiments is revealed by a comparison of arterio-venous differences. In selecting TH and TL lines, pH determinations were made from arterial blood compared to venous blood in the pHH and pHL strains. Selection using arterial blood has the effect of magnifying the arterio-venous difference in pH in the high line and reducing it in the low line. The opposite is true in pHH and pHL strains. It seems evident that different loci are involved in the two experiments.

Phenotypic variance did not decrease as selection advanced, and no reduction in genetic variance is inferred. Natural selection or a physiological limit do not appear to be limiting factors to selection. Selection limits are postulated to be due for the most part to negative correlations between multiple targets of selection. There is no clear evidence for genetic homeostasis.

A significant change in sex ratio occurred as a correlated response to selection. The TH line has a higher percentage of females; the TL line has a higher percentage of males. The change in sex ratio was opposite to that observed in pHH and pHL strains.

Microfilm \$2.50; Xerox \$3.80. 68 pages.

## BOTANY

### ORIGIN AND DEVELOPMENT OF THE APICAL MERISTEMS IN THE EMBRYO OF *Acer saccharinum* L.

(L. C. Card No. Mic 60-4173)

David Andrew Haskell, Ph.D.  
Purdue University, 1960

Major Professor: S. N. Postlethwait

Plant anatomists have long encountered considerable difficulty in formulating acceptable concepts concerning the structure and growth relations of the apical regions of shoots and roots. At the present time these meristems are undergoing extensive re-examination. It is noted that existing theories, many of which are contradictory, are not founded on knowledge of how these meristems arise in the embryo. The present study was undertaken to record the cytological and anatomical events which attend the formation of apical meristems in the embryo of *Acer saccharinum* L. The embryo of silver maple is especially adapted and convenient for histogenetic study.

The proembryonic tetrad in *A. saccharinum* is T-shaped. A wedge-shaped epiphysis is produced by one cell of the

apical pair; the basal cell does not produce a suspensor, but functions as the hypophysis. Growth during the early phase of enlargement is massive, bi-radial, and accretionary. Histological differentiation is gradual and delayed by comparison with embryos having a more symmetrical cell arrangement. Initially, the embryonic epidermis divides periclinally and anticlinally, but later is separable into zones according to the direction of mitosis. The inner tissue includes three distinct zones: a midsection of stratified, columnar cells, and two polar caps of unstratified, polygonal cells. The midsection entirely produces the hypocotyl; the polar caps are respectively the organizational centers of the shoot apex and root apex. The polar caps are definable cytohistologically, positionally, and functionally in all stages of apical development. The apical polar cap becomes the summital axial portion of the corpus; the basal polar cap is equivalent in all respects to the "quiescent center" of recent literature. Both polar caps are always surrounded by tissue showing higher mitotic frequency.

The shoot apex is anatomically defined before initiation of the cotyledons by the establishment of a uniseriate, anticlinally-dividing, tunical plate over the apical polar cap. A well-defined lateral ring of tunica cells which divide

periclinally initiates the cotyledons. This lateral ring is not reconstituted in the epicotyl apex. The polar cap cells do not contribute to cotyledon development. Zonation and growth organization of the apex increases in complexity with growth of the epicotyl; cell number increases and cell size decreases.

Initial evidence of the formation of a root meristem is the formation of longitudinal ribs during development of the basal peg of hypophyseal tissue. These ribs underlie the basal polar cap and become the meristematic columella of the root cap. The polar cap region is distinguishable as the focal point of longitudinal and transverse wall formation in the lower region of the embryo and as a zone of transition between the columnar cells of the hypocotyl and the flattened cells of the columella. A columella meristem develops among the upper rib cells. Initiating meristems of the stele and cortex enclose the polar cap on its proximal side. They arise late in the ontogeny of the root apex, gradually appearing as residual sites of the same meristematic activity which is found throughout the hypocotyl during earlier growth. In all stages of root apex development there is little correlation between genetical cell lineages, zonation, and tissue differentiation.

The results of this study clearly demonstrate the need for further work concerning the apical organization of angiosperms. It is certain that concepts of structure and growth which are derived from observation limited to mature shoots and roots must be held in question until the embryo has been examined more thoroughly. A review of the literature pertaining to the embryonic origin and early development of apical meristems is included. All illustrations are scaled line drawings prepared from actual sections by microprojection.

Microfilm \$2.50; Xerox \$7.20. 152 pages.

#### THE CYTOLOGY AND TAXONOMY OF USTILAGO COMMELINAE

(L. C. Card No. Mic 60-3955)

Donald Davis McLain, Jr., Ph.D.  
University of Illinois, 1960

The nuclear cycle, germination, infection, and sporulation for *Ustilago commelinae* (Kom.) Zundel are reported. It is found that meiosis occurs in the smut spore, and that two of the meiotic products disintegrate before germination takes place. The remaining haploid nuclei migrate into a promycelium, which becomes two-celled, each cell containing a single haploid nucleus. Germination of the promycelium cells is direct, by germ tubes into which mitotically derived nuclei migrate and which consequently develop into dicaryotic infection hyphae. Infection of the host, which is susceptible for some time, is of the seedling-infection type. Parasitizing hyphae are found to form typical basidiomycetous clamp connections at intervals along their lengths. Clamp formation for this organism is described and found similar to that of hymenomycetous fungi. Sporulation is intercalary, and takes place in the gynoeceum of the host. A clamp connection subtends each cell forming a spore. The smut spores are binucleate at maturity but become diploid shortly before germination. Infection is systemic, causing a reduced vigor of the host and complete replacement of the ovules.

Study of the cytological events occurring in this organism indicates that *Ustilago commelinae* (Kom.) Zundel is a truly homothallic species as typified by Blakeslee (1904).

The taxonomy of this smut fungus is clarified and its transfer to the genus *Ustilago* is confirmed.

Microfilm \$2.50; Xerox \$3.00. 29 pages.

#### NEW JERSEY LIMESTONE VEGETATION

(L. C. Card No. Mic 60-4248)

Philip Richardson Pearson, Jr., Ph.D.  
Rutgers University, 1960

Major Professor: Dr. Murray F. Buell

In the Great Valley of northern New Jersey, a series of forest stands occurring on limestone and marble were studied to determine their relationship to one another and to the forests of the surrounding areas.

Data were gathered by a combination of the four point quarter, line intercept, and quadrat methods.

An examination of importance values indicated that white oak (*Quercus alba* L.), black oak (*Quercus velutina* Lam.), sugar maple (*Acer saccharum* Marsh.) and hemlock (*Tsuga canadensis* (L.) Carr.) were the only four species dominating the stands. On the basis of these four species, the stands were classified into three types: 1. sub-xeric or oak dominated stands, 2. sub-mesic or sugar maple dominated stands, and 3. mesic or hemlock dominated stands.

Successional trends in each stand were determined by examining the numbers of seedlings, saplings, and small trees of the four dominant species. In the majority of stands, the evidence points to sugar maple as replacing the oaks in the future. Hemlock is considered to be an important component of the forest and will probably share dominance with sugar maple in the future.

The forests bordering on the Great Valley of northern New Jersey are the Hemlock-Northern Hardwoods forest to the west and north and the Oak-Hickory forest to the south and east. On limestone in northern New Jersey, the Oak-Hickory forest typical of the Great Valley further south is being converted to a modified Hemlock-Hardwoods community as a result of late forest succession.

Microfilm \$2.50; Xerox \$5.20. 105 pages.

#### CYTOGENETIC STUDIES OF TETRAPLOID HYBRIDS OF *EUCHLAENA PERENNIS* AND *ZEA MAYS*

(L. C. Card No. Mic 60-3994)

Donald LaVergne Shaver, Ph.D.  
University of Illinois, 1960

Allotetraploid hybrids were made between 4N maize genetic stocks and 4N *Euchlaena perennis* (Hitchc.). Gene segregation and linkage were studied in seven marked regions in the hybrid and in corresponding 4N maize controls.

The segregation of 11 different markers was significantly altered in the intergeneric hybrid as compared to



maize controls. The coefficients of preferential segregation ranged from .399 to .869. Gene ratios from the tetraploid hybrids indicate a degree of chromosome homology which is intermediate to that found by the same test for species within five other genera. The comparison suggests that the relationship between *Zea* and *Euchlaena* is congeneric.

Linkage, as measured by the coefficient of tetraploid linkage, was stronger in the hybrid than in the *Zea* controls for four of the six regions compared. This was consistent with cytological data indicating a reduction in chiasma frequency in the hybrid as compared to *Zea*. In the wx - C segment, crossing over appeared to be higher in the hybrid than in the control, in spite of the fact that no crossing over occurred in overlapping wx - sh<sub>1</sub> and wx - yg<sub>2</sub> regions. Apparently the inheritance of the C locus in *Euchlaena* - *Zea* hybrids is irregular. The apparent increase in crossing over in the Y - Pl region of the hybrid may be due to the fact that the frequency of chromosome 6 quadrivalents involving partner exchanges is twice the average frequency for the other nine chromosomes.

The clone of *E. perennis* used in this study was found to be heterozygous for the sh<sub>1</sub> locus, and is probably triplex.

The range in chromosome numbers in the progeny of a randomly intercrossing population of 92 4N maize plants was found to be the same as in the progeny of 40 chromosome plants. Distribution of numbers within the range of 36 to 43 was, however, significantly skewed towards hypoploidy. The chromosome numbers in the intergeneric

hybrid plants varied from 29 to 44 and the range was significantly greater than in either of the two *Zea* populations.

*E. perennis* was found to have a different meiotic behavior from 4N *Zea*. Quadrivalent frequency was only .499, as compared to .871 in *Zea*. Quadrivalent configurations were restricted to two types in *E. perennis*, whereas 10 types were found in 4N *Zea*. These observations are compatible with a reduction of chiasma frequency to one or less per single chromosome arm in *E. perennis*. The minimal chiasma number, as estimated from quadrivalent configurations, is 3.897 in *E. perennis*, as compared to 4.202 for *Zea*, and 4.045 in the hybrid.

Correlated cytological and genetical data from chromosome 6 indicate that the great majority, and probably all, of the bivalents for chromosome 6 was homosynaptic, since random disjunction of chromosome 6 quadrivalents satisfactorily accounts for the observed frequency of recessive y gametes.

Significant differences in gametic ratios from different autotetraploid plants of the same genetic constitution were more or less general. Since in one case, significant differences in arrays of gametes between the male and female flowers of the same plants were found, part of the differences in ratios may result from gametophyte competition. Inasmuch as differences between plants of the same genetic constitution were found as often in the intergeneric hybrids as in the *Zea* controls, it is unnecessary to assume that chromosome differentiation has occurred in *E. perennis*.

Microfilm \$2.50; Xerox \$5.00. 97 pages.

## CHEMISTRY

### CHEMISTRY, GENERAL

#### MASS AND CHARGE DISTRIBUTIONS FROM THE FISSION OF URANIUM ISOTOPES INDUCED BY INTERMEDIATE ENERGY HELIUM IONS

(L. C. Card No. Mic 60-4160)

Lewis James Colby, Jr., Ph.D.  
Purdue University, 1960

Major Professor: James W. Cobble

The determination of accurate total interaction cross sections can be experimentally performed only if all of the individual possible reactions are known and can be measured. Since the fission reaction in the heavy elements accounts for the largest part of the total reaction cross section and since the total fission cross section can be accurately determined from a smooth mass yield curve drawn through specific experimental points, it was quite logical that these experimental total interaction cross sections should give the most sensitive test to various theoretical treatments. After developing improved chemical and radiochemical techniques, accurate fission cross sections were determined for 39.9 and 33.8 Mev helium ions on  $U^{238}$  and 40.5, 34.5, 29.0 and 25.3 Mev helium ions on  $U^{235}$ .

A summary of the results for mass distributions show that:

- (1) The mass yield curves for  $U^{235}$  excited with 20-40 Mev helium ions show a pronounced middle peak (triple hump) in the symmetric mode of fission.
- (2) The total reaction cross section data is in good agreement with the alpha particle elastic scattering data and that the radius of  $1.41 \times 10^{-13}$  cm. is essentially confirmed when the interaction radius of  $2.19 \times 10^{-13}$  cm. for the alpha particle is used.
- (3) The radius parameter for the various uranium isotopes is essentially constant.
- (4) The average number of total neutrons emitted per fission for a given excitation energy is less than previously reported.

The conclusions and possible ideas obtained from charge distribution considerations are summarized as follows:

- 1) The primary yield results essentially are best correlated by the Constant-Charge-Ratio (CCR) rule for 20-40 Mev helium ions on uranium isotopes, although a complex process involving aspects of both the CCR and ECD rules may be the correct interpretation.
- 2) There is evidence of a 82 neutron shell effect on the primary yields which possibly could lead to a

perturbed charge distribution when these cross closed shells.

- 3) The shape of an unperturbed charge distribution curve is symmetric about a most probable charge and is nearly gaussian.
- 4) A new method for accurately counting  $I^{130}$  in the presence of high activities of other iodine isotopes has been developed, leading to accurate primary yield cross sections for this nuclide.

Microfilm \$2.70; Xerox \$12.15. 206 pages.

### CHEMISTRY, ANALYTICAL

#### SOME FACTORS IN THE SOLUTION RESIDUE METHOD OF SPECTROCHEMICAL ANALYSIS

(L. C. Card No. Mic 60-4233)

Clarence Lewis Grant, Ph.D.  
Rutgers University, 1960

Major Professor: William J. Hanna

Spectrochemical methods for the analysis of various agricultural and biological materials should be adaptable to changing elemental composition and to various acid solutions. In addition, ability to handle samples containing low levels of radioactive tracers would be an asset. The solution residue method, employing high voltage A.C. spark excitation, has been shown to hold considerable promise for such analyses. A high inductance, arc-like discharge was found to provide good sensitivity and reproducibility. However, in order to obtain high precision and still maintain simplicity and broad applicability, it was necessary to reduce certain troublesome interferences.

One of the major difficulties with this procedure proved to be repression of spectral line intensity when residues were dried on graphite electrodes "acid-proofed" with paraffin or Apiezon N. This effect was observed for  $HNO_3$ ,  $HClO_4$ , and  $H_2SO_4$  but not for  $HCl$  or  $HAc$ . In addition, intensity ratios were markedly affected. This difficulty was eliminated by preventing penetration of solutions into the electrodes by using Plicene or polyethylene as "acid-proofing" agents. Two methods were developed for the quantitative evaluation of the effectiveness of such reagents for preventing penetration.

The feasibility of using Ni or Li as a spectroscopic buffer was studied in  $HNO_3$  solutions. Because of differences in the physical nature of the deposits, the volatilization rates of impurity elements were much more similar to that of Li than Ni. Despite this fact, the reproducibility of log intensity ratios for line pairs which were closely



matched in excitation potential and wavelength proximity, was equally good in both buffers.

The interelement effects of P, K, and Na were masked more effectively by Li than by Ni. The most troublesome element in this regard was P, but it was not possible to generalize its effects.

The observed coefficients of variation for log intensity ratios ranged from  $\pm 1.8\%$  to  $\pm 4.2\%$ , based on the assumption that a typical analytical curve will cover a difference in log intensity ratio of 1.00 units. These values contain all of the normal operational variability, but may be somewhat biased on the low side because the standards used were rather near the concentration index in most cases.

A statistical control procedure has been proposed as a means of detecting plates whose photographic response lies outside the limits of usual variability. The procedure involves establishment of tolerance intervals about the analytical curve. Plates bearing exposures of unknowns and one standard are then accepted or rejected on the basis of whether the log intensity ratio of the standard lies inside or outside of the tolerance intervals.

Microfilm \$2.50; Xerox \$5.00. 96 pages.

#### MOLECULAR-WEIGHT DISTRIBUTION OF GRAHAM SALTS

(L. C. Card No. Mic 60-4242)

William Stephen Martens, Ph.D.  
Rutgers University, 1960

Major Professor: Wm. Rieman III

The purpose of this investigation was to develop a method for the determination of the molecular-weight distribution of Graham salts,  $\text{Na}_n\text{P}_{n+2}\text{O}_{3n+1}$ , and to compare the experimental distributions with theoretical ones.

Frontal analysis and crystallization chromatography were tried and found unsatisfactory for the fractionation of Graham salts.

A fractional-precipitation method with acetone as a precipitant has been developed for the fractionation of Graham salts. Optimum conditions of all the fractionation parameters were investigated. A micro procedure was used. Molecular weights were determined by end-group titrations, and cyclic compounds were corrected for by precipitation of the linear polyphosphates with  $\text{Ba}^{++}$  at pH 7.0.

The method has been used to determine the molecular-weight distributions of Graham salts with number-average molecular weights between 4,500 and 16,000. It has also been applied to mixtures of two Graham salts. The distributions obtained follow, within the limits of experimental error, the random-distribution equation developed by Van Wazer.

The described method offers a number of modifications and improvements compared with Van Wazer's fractionations.

(1) Optimum conditions of (a) initial polyphosphate concentration, (b) volume ratio of the two phases, (c) homogeneous precipitation, (d) number of fractions, and (e) size of sample were used.

(2) Degradation during the fractionation was decreased to about 2%.

(3) Cyclic polyphosphates were corrected for both in the initial analysis of the Graham salt and in the subsequent molecular-weight determinations of the fractions.

(4) The probable limits of random errors were included in the curves of molecular-weight distribution.

Microfilm \$2.50; Xerox \$7.80. 168 pages.

#### SPECTROPHOTOMETRIC METHODS FOR THE DETERMINATION OF CHROMIUM AND MANGANESE IN HUMAN PLASMA AND RED CELLS

(L. C. Card No. Mic 60-4612)

Dwight Otis Miller, Ph.D.  
University of Virginia, 1960

The spectrophotometric method for the determination of traces of chromium is based upon the red-violet complex which is formed by the reaction of dichromate with diphenylcarbazide in sulfuric or perchloric acid. Two oxidation procedures were developed for the conversion of chromium (III) to chromium (VI) in acid medium. Iron interfered in the red cell analysis and was removed by precipitation with cupferron and extraction of the complex with chloroform. The chromium distribution between the two phases was followed by extraction of synthetic red-cell samples which contained radioactive chromium-51. Comparative counting of the radiation from aliquots of the organic and aqueous phases showed that no chromium was extracted into the chloroform.

The procedure was scaled down so that the smallest practicable sample could be analyzed. All apparatus was scrupulously cleaned to avoid contamination. The mineral constituents of plasma and red cells were isolated by a combination of wet and dry ashing methods. Eight plasma samples were analyzed: the chromium concentration ranged from 0.017 to 0.052 p.p.m., the average value being 0.030 p.p.m. Six red-cell samples showed a range of chromium values from 0.014 to 0.038 p.p.m.

A new spectrophotometric method for the determination of manganese with benzohydroxamic acid is presented. The Mn-benzohydroxamic acid complex forms rapidly in ammonium hydroxide when the pH is above 10. Above pH 10, the concentration of ammonium hydroxide is not critical and the absorbance of a complex solution is not changed by molar concentrations of ammonia. The complex is red-brown in color and has an absorption maximum at 500 m $\mu$ . The sensitivity of the color reaction is 0.016  $\gamma$  Mn/cm<sup>2</sup> for  $\log I_0/I = 0.001$ . Interference is limited to cobalt, copper and those ions which are insoluble in ammonium hydroxide, i.e., iron (III). A separation of manganese from iron, cobalt and copper with Dowex-1, 8X anion exchange resin is included in this study.

The color reaction is adaptable to the determination of manganese in non-aqueous solvents, such as ethanol, acetone and dimethylformamide. Optimum conditions for the reaction in dimethylformamide have been established.

Reaction of the enol form of the reagent with manganese (II), followed by oxidation of the manganese to the +3 state, is postulated. The empirical formula of the complex is  $\text{R}_3\text{Mn}$  and it is an anion.

The method has been successfully applied to the determination of manganese in National Bureau of Standards

steel, bronze and magnesium samples and to the determination of manganese in human plasma and red cells.  
Microfilm \$2.50; Xerox \$6.40. 131 pages.

# REACTIONS IN CONCENTRATED SULFURIC ACID

(L. C. Card No. Mic 60-4192)

James Monroe Miller, Jr., Ph.D.  
Purdue University, 1960

Major Professor: Warren W. Brandt

The purpose of this investigation was to identify the reactions which anthracene (AH) and 2,3,5-Trimethylphenol (TMP) undergo in concentrated  $H_2SO_4$ . Three types of reactions have been reported previously, namely sulfonation, protonation, and oxidation.

The principle method of investigation was by absorption spectroscopy, although fluorescence and electron spin resonance (ESR) spectroscopy were also used. To interpret the absorption spectra obtained, it was necessary to investigate the spectral properties of some sulfonic acids. Therefore, benzene, toluene, and phenol were studied in  $H_2SO_4$ .

It has been concluded that AH is protonated immediately upon dissolution in 96 per cent  $H_2SO_4$ . The spectrum of the protonated species,  $AH_2^+$ , has a strong absorption band (molar extinction coefficient,  $\epsilon = 4.7 \times 10^4$ ) at  $415 m\mu$  ( $2.41 \times 10^4 cm^{-1}$ ) and weaker bands at  $282 m\mu$  ( $3.55 \times 10^4 cm^{-1}$ ) ( $\epsilon = 6 \times 10^3$ ) and  $225 m\mu$  ( $4.44 \times 10^4 cm^{-1}$ ) ( $\epsilon = 2.5 \times 10^4$ ). The  $pK$  for this reaction was found to be  $-8.0$  by studying the change in absorbance at  $415 m\mu$  as a function of  $H_2SO_4$  concentration.

After the protonation, both sulfonation and oxidation occur slowly. About 40 per cent of the AH was sulfonated in 30 minutes at room temperature. The product,  $ASO_3H$ , was isolated and identified by infrared spectroscopy. Oxidation resulted in a paramagnetic ion,  $\cdot AH^+$ , which can be formed from AH by a loss of one electron. The maximum amount formed was 4.7 per cent of the total AH concentration and was attained after 60 minutes. The oxidizing species probably is not  $H_2SO_4$  but rather an "impurity" such as oxygen.

Spectra of  $AH_2^+$ ,  $\cdot AH^+$ , and  $ASO_3H$  have provided the necessary data for the interpretation of the spectral changes which were observed during oxidation and sulfonation. Isosbestic points were obtained for 60 minutes at  $235 m\mu$  ( $3.26 \times 10^4 cm^{-1}$ ),  $368 m\mu$  ( $2.72 \times 10^4 cm^{-1}$ ), and  $500 m\mu$  ( $2.00 \times 10^4 cm^{-1}$ ).

The species  $\cdot AH^+$  was also formed in a 1:1 reaction between Fe(III) and AH in 96 per cent  $H_2SO_4$ . The AH appeared to be quantitatively oxidized to  $\cdot AH^+$  immediately upon dissolution. It was identified by its ESR spectrum. This reaction and the accompanying spectrum provided the information necessary to establish the presence and concentration of  $\cdot AH^+$  in the  $AH-H_2SO_4$  oxidation in the absence of Fe(III). Attempts were made to perform this reaction with 12 other ions, but none was as effective as Fe(III).

It has been concluded that TMP is also quickly protonated in 96 per cent  $H_2SO_4$ . The protonated species has strong absorption bands at  $320 m\mu$  ( $3.13 \times 10^4 cm^{-1}$ )

( $\epsilon = 1.0 \times 10^4$ ) and  $260 m\mu$  ( $3.85 \times 10^4 cm^{-1}$ ) ( $\epsilon = 1.5 \times 10^4$ ). An identical spectrum was also obtained in another strong acid, 72 per cent  $HClO_4$ , thus substantiating this conclusion.

In  $H_2SO_4$ , a slow sulfonation followed the protonation, reaching equilibrium between the protonated and sulfonated species in about 2 hours. In the spectrum representing the sulfonation reaction, isosbestic points were formed at  $243 m\mu$  ( $4.12 \times 10^4 cm^{-1}$ ),  $270 m\mu$  ( $3.70 \times 10^4 cm^{-1}$ ), and  $293 m\mu$  ( $3.41 \times 10^4 cm^{-1}$ ). The sulfonic acid was isolated and identified by infrared spectroscopy. The equilibrium was also reached from the other direction by dissolving sulfonated TMP in 96 per cent  $H_2SO_4$ .

From the compounds studied, it was observed that the absorption band for the  $^1L_b \leftarrow ^1A$  transition is shifted to slightly longer wavelengths, is increased in intensity, and has a slightly changed vibrational pattern when the compound is sulfonated. The absorption band for the  $^1L_a \leftarrow ^1A$  transition usually shows an increase in intensity and a larger wavelength shift to longer wavelengths than the  $L_b$  band. These observations are in general agreement with the theoretical predictions. The data are summarized in the following table.

Spectral Properties of  
the Sulfonated Compounds Studied.  
Solvent is  $H_2O$  or dil.  $H_2SO_4$ .

Compound	$L_b$ Band		$L_a$ Band	
	$\lambda$ (m $\mu$ )	$\epsilon$	$\lambda$ (m $\mu$ )	$\epsilon$
Anthracenesulfonic Acid	374	$1 \times 10^4$	254	$2 \times 10^5$
Benzenesulfonic Acid	263	$4.8 \times 10^2$	213	$8.1 \times 10^3$
p-Phenolsulfonic Acid	270	$9.0 \times 10^2$	230	$1.2 \times 10^4$
p-Toluenesulfonic Acid	261	$3.4 \times 10^2$	222	$1.1 \times 10^4$
2,3,5-Trimethylphenol-sulfonic Acid	287	$5 \times 10^3$	232*	$9 \times 10^3$

\*Inflection

Microfilm \$2.50; Xerox \$6.20. 127 pages.

# THE APPLICATION OF DISPERSED SODIUM TO THE SELECTIVE DETERMINATION OF ACTIVE HYDROGEN

(L. C. Card No. Mic 60-4334)

Patricia R. Mohilner, Ph.D.  
University of Kansas, 1960

The reactivity of metallic sodium and its availability in the convenient form of dispersions in inert organic solvents suggested that dispersions of sodium could be used as a reagent to determine active hydrogen in organic compounds.

Three approaches were used in this investigation. Dispersions of sodium prepared in xylene were standardized by adding an aliquot to ethanol and titrating the resulting base with standard acetic acid in three parts xylene and one part ethanol by volume. Aliquots of the



standardized dispersion were added to weighed samples of organic compounds and allowed to stand for about five minutes. An excess of ethanol was added to the sample and the resulting base titrated with standard acetic acid, the difference in titer being the amount of sodium used up in reaction with the sample. Organic acids and some phenols were found to react quantitatively, p-dibromobenzene was found to react partially and other substances investigated were found to give no reaction detectable by this method.

In the second approach, samples were added to boiling dispersions in xylene and the evolved gas collected and measured in a gas buret. Acids and phenols were found to react by this procedure while amines showed no reaction.

The third approach studied was the addition of a liquid sample or a solution of a solid sample in dioxane to sodium dispersed in two parts of dioxane to one part of xylene by volume in an evacuated apparatus of known volume, the pressure change after addition of the sample being noted.

The method developed in the third procedure permits the selective determination of active hydrogen in alcohols, phenols, aliphatic and aromatic acids, acetylated amines and sulfonic acids without reaction being obtained from aliphatic and aromatic amines, aldehydes, ketones, esters, nitriles, 1-acetylenes and azo compounds. Interfering reactions by nitro and halo groups were not found.

The error in the method was a function of sample size and in favorable cases (liquid samples) was of the order of 1% while in the case of solids used in solution was usually about 10% because of the limited sample size due to solubility.

A complete classification of active hydrogen compounds into three reactivity types can be made by use of the back-titration procedure with dispersed sodium to determine only the most reactive hydrogen in organic molecules, the method of measuring pressure change in a constant volume system after reaction with dispersed sodium to obtain all active hydrogens except those listed as non-reactive above and a Zerewitnoff or similar conventional determination to obtain the total active hydrogen.

Microfilm \$2.50; Xerox \$4.60. 87 pages.

#### DERIVATIVES OF 1,4-DIHYDROXYANTHRAQUINONE AS COLORIMETRIC REAGENTS FOR THE DETERMINATION OF ALUMINUM, BERYLLIUM AND THORIUM.

(L. C. Card No. Mic 60-4614)

Elbert Guy Owens II, Ph.D.  
University of Virginia, 1960

New methods have been developed for the spectrophotometric determination of aluminum and beryllium using derivatives of 1,4-dihydroxyanthraquinone. The methods are sensitive and applicable to trace analysis. Separation of interferences is accomplished either by ion exchange or by electrolysis at the mercury cathode. Many interferences present in moderate concentrations are masked by adding salts of ethylenediaminetetraacetic acid (EDTA) as sequestering agents.

A new indicator, 2-phenoxyquinizarin-3,4'-disulfonic acid (dipotassium salt), has been used for the complexo-

metric titration of thorium with disodium EDTA. The applicable pH range for stoichiometric titration is pH 1.6 to 3.4.

The reaction of 2-quinizarinsulfonic acid (sodium salt) with aluminum ions in methanol to give a stable violet complex has been applied to the spectrophotometric determination of aluminum. Tolerance levels of 46 diverse ions are reported. The method has been successfully applied to several bronze and steel samples after separation of interfering ions from aluminum with the mercury cathode. Interfering ions not thus removed are:  $\text{Be}^{+2}$ ,  $\text{Sc}^{+3}$ ,  $\text{Th}^{+4}$ ,  $\text{Ti}^{+4}$ ,  $\text{Y}^{+3}$ ,  $\text{Zr}^{+4}$ ,  $\text{F}^{-1}$ ,  $\text{PO}_4^{-3}$ , and the rare earths.

Optimum concentration of aluminum in bronze or steel is 0.01 to 1.0%. The reaction has a spectrophotometric sensitivity of 1 part of aluminum in 50,000,000 parts of solution. Maximum wavelength of absorbance for the 1 to 1 complex is at 560 m $\mu$  and Beer's law is obeyed up to an aluminum concentration of 1.7 p.p.m. Effects of exposure to light, variation of temperature, and order of addition of reagents are negligible.

Beryllium forms a 1 to 1 complex with 2-phenoxyquinizarin-3,4'-disulfonic acid (disodium salt) at pH 6.0 in aqueous solution. The wavelength of maximum absorbance for the complex is at 550 m $\mu$ . This reaction has been applied to the spectrophotometric determination of beryllium in beryl ore, aluminum metal, copper alloys, and "seeded" samples of bronze and steel. The sensitivity of the reaction is 1 part of beryllium in 125,000,000 parts of solution. Optimum concentration of beryllium in the solution measured is from 0.1 to 0.7 p.p.m.; Beer's law is not obeyed but the absorbance-concentration curve is nearly linear over this range. Moderate concentrations of interferences are masked with the calcium salt of EDTA. Out of 64 ions investigated for interference only  $\text{Cr}^{+3}$ ,  $\text{F}^{-1}$ ,  $\text{Mg}^{+2}$ ,  $\text{PO}_4^{-3}$ ,  $\text{Th}^{+4}$ , and  $\text{Zr}^{+4}$  interfere seriously in the method when CaEDTA is added as a sequestering agent. Large quantities of interferences are separated from beryllium by ion exchange (Amberlite IR 120) or electrolysis at the mercury cathode. Temperature variations should be held to within  $\pm 5^\circ \text{C}$ . Using two masking agents (CaEDTA and CdEDTA) both beryllium and aluminum can be determined with an accuracy for the aluminum of about  $\pm 10\%$ ; the accuracy for beryllium is  $\pm 2\frac{1}{2}\%$ .

Microfilm \$2.50; Xerox \$6.60. 137 pages.

#### CHEMISTRY, BIOLOGICAL

##### EFFECTS OF SODIUM, POTASSIUM AND CHLORIDE IONS ON CARBOHYDRATE CATABOLISM IN RAT HEART HOMOGENATES

(L. C. Card No. Mic 60-3566)

Robert Roald Blanken, Ph.D.  
University of Pennsylvania, 1960

Supervisor: Niels Haugaard

Stimulated by previous studies on the rat heart homogenate, a complex, self-contained system requiring only the presence of an oxidizable substrate, potassium and chloride

ions, and a high concentration of diphosphopyridine nucleotide (DPN) to enable the particulate and supernatant fractions to cooperate in carrying out their respective oxidative and glycolytic functions at rates comparable to those in intact cells, the author has used the Warburg technique and spectrophotometric methods to investigate the mode and locus of action of sodium ions and the interrelationships between the metabolism of carbohydrates and adenine or pyridine nucleotides.

Following an extensive review of the literature on the effects of inorganic ions on biological processes, with special reference to the effects of potassium and sodium on carbohydrate metabolism in microorganisms, tissue slices and cell-free systems, the author reports results which indicate that potassium, rubidium and ammonium ions are stimulatory for glucose oxidation, the anaerobic glycolysis of hexose diphosphate and, to a lesser extent, the oxidation of glycogen, glucose-6-phosphate, 3-phosphoglyceric acid and pyruvate, while the oxidation of fructose-1,6-diphosphate, succinate,  $\alpha$ -ketoglutarate and reduced DPN, as well as oxidative phosphorylation, the hexokinase reaction *per se* and the breakdown of DPN and adenylic acid, proceed independently of the addition of exogenous potassium. In addition, chloride ions have been found to be stimulatory, the high DPN requirement has been found to be due primarily to its breakdown to adenylic acid, and the inhibitory effect of sodium on glucose oxidation has been successfully reversed by the addition of exogenous ATP or adenylic acid.

It is concluded that the effects of sodium and potassium on glucose oxidation in this system are localized primarily to the initial phosphorylative steps in glucose catabolism, the unique size of the potassium ion enabling it to play a role in correlating the activities of enzyme, substrate and coenzyme during the transfer of high-energy phosphate and the production or utilization of adenylic acid.

Microfilm \$2.50; Xerox \$6.60. 140 pages.

#### PARATHYROID FUNCTION AND PLASMA CALCIUM DISTRIBUTION

(L. C. Card No. Mic 60-4740)

Moir Breen, Ph.D.  
Northwestern University, 1960

Any direct role that the parathyroid glands play as regards plasma calcium distribution is still in doubt. To date, there is evidence for three conflicting views, viz: that the parathyroid glands increase, decrease or have no effect on the calcium combining power of the plasma proteins.

The present investigation was an attempt to study this question further and to determine more conclusively the exact relationship between parathyroid function and plasma calcium distribution.

The total plasma calcium levels were varied *in vivo*, by removal of the parathyroids in dogs, followed by administration of the parathyroid hormone. The plasma calcium distribution was also studied in normal and parathyroidectomized rats, and in normal and hyperparathyroid human beings. In all species studied hyperparathyroidism increased and hypoparathyroidism reduced the

total plasma calcium, non protein-bound calcium, the protein bound calcium and the ratio of non protein-bound calcium / total plasma calcium.

Total plasma calcium levels were varied *in vitro* in two ways:—(1) by the addition of calcium to plasma from parathyroidectomized dogs until normal and hypercalcemic levels were attained. (2) by first decalcifying plasma from normal and parathyroidectomized dogs, using a chelating resin column, and then adding calcium until hypo-, normal and hypercalcemic levels were reached. The plasma calcium distribution was the same in both groups, viz:—that with an increase in the total plasma calcium there was a corresponding increase in the non protein-bound calcium, and in increase in the ratio of non protein-bound calcium / total plasma calcium.

In conclusion, the parathyroid hormone controls the total plasma calcium levels but the distribution of calcium between the protein and non-protein fractions is independent of parathyroid function and is more satisfactorily explained by the multiple equilibria concept of Klotz for protein-calcium binding.

The effect of experimentally induced hypercitricemia on the distribution of plasma calcium was studied in normal and parathyroidectomized female rats. Hypercitricemia was produced by bilateral nephrectomy. It was observed that the increase in the calcium is in the diffusible portion of the plasma, and is due to an increase in the diffusible complexed calcium which is probably calcium-citrate. The protein-bound calcium and the ionized calcium fractions were not altered significantly. Bilateral nephrectomy of parathyroidectomized rats caused a similar qualitative response in the plasma calcium distribution, but the hypercitricemia and calcium rise of the latter group was quantitatively less. Evidently the mobilization of calcium from bone is sufficient in hypercitricemia so that the initial ionized plasma calcium levels are maintained independent of parathyroid function.

The Spinco/Beckman model L ultracentrifuge was investigated as a means of determining non protein-bound calcium in plasma. It proved to be a very simple method of high precision. pH and temperature were very easily and effectively controlled. This was the method used in studying the plasma calcium distribution in the above experiments. Microfilm \$2.50; Xerox \$6.20. 126 pages.

#### MECHANISMS OF GLUCOSE PRODUCTION BY LIVER CELLS

(L. C. Card No. Mic 60-3885)

Ronald Webster Brosemer, Ph.D.  
University of Illinois, 1960

(1) Cells isolated from rat liver accumulate glucose in the incubation medium; a variety of sera stimulate this glucose production. Evidence is presented to show that glycogen and other carbohydrates are the precursors of the glucose.

(2) The observations that the glucogenic factor in serum has properties similar to an enzyme and that maltose increases the glucose production by liver cells leads to the postulate that the factor is maltase. This is verified by the correlation between the maltase level and



the factor activity of various sera and highly purified horse serum maltase. The purified maltase hydrolyzes maltotriose and maltotetraose as well as maltose. It is suggested that the serum enzyme be termed  $\alpha$ -1,4-oligoglucosidase.

(3) Amylase was shown to be present in rat liver. The enzyme is located in the microsomal fraction; its activity is stimulated by sonication. The enzyme was partially purified and shown to be an  $\alpha$ -amylase by the following criteria: (1) chloride stimulation, (2) ratio of increase in reducing power to decrease in iodine-color, (3) complete loss of iodine-color of the substrate upon extended action of the enzyme, (4) reversible inhibition by EDTA, (5) chromatography of products. This is the first conclusive evidence that the liver contains an  $\alpha$ -amylase. Amylase activity in homogenates of rabbit, sheep, and pork liver was measured. The liver amylase to phosphorylase ratio for rat is much higher than for the other three species.

(4) A low level of oligoglucosidase was found in rat liver. The oligoglucoside production by isolated rat liver cells and the stimulation of glucose production by exogenous oligoglucosidase is consistent with the high amylase and low oligoglucosidase levels in the liver cell.

(5) Liver slices produce oligoglucosides, but perfused whole livers do not. Since the liver amylase is cryptic, it is suggested that physical damage to cells results in the accumulation of oligoglucosides in isolated liver cells and slices.

(6) It is concluded that the amylase pathway is a significant route for the breakdown of glycogen in isolated liver cells and slices, but is not a primary route of blood glucose formation in the perfused whole liver. It is suggested that liver amylase may function as: 1) a source of a small amount of glucose, 2) a source of primers for glycogen synthesis, or 3) a source of extra-hepatic amylase. Microfilm \$2.50; Xerox \$4.80. 94 pages.

#### GASEOUS NITROGEN PRODUCTS RESULTING FROM DENITRIFICATION REACTIONS IN SOILS

(L. C. Card No. Mic 60-3719)

Foster Bernard Cady, Jr., Ph.D.  
North Carolina State College, 1960

Supervisor: William Victor Bartholomew

Soil samples containing tagged nitrate were incubated in a compact, small-volume, glass apparatus constructed to provide internal circulation of the gaseous phase. Periodically, samples of the circulating gas were taken and analyzed directly on the mass spectrometer.

The initial gaseous product to appear was nitric oxide (NO). However, the amount of NO to appear in the gaseous phase never exceeded 5 percent of the tagged nitrate added to the soil. Subsequent to the appearance of nitric oxide, nitrous oxide ( $N_2O$ ) appeared in the gaseous phase. Coincident with the increase in  $N_2O$  was a decrease and eventual disappearance of NO. Following the increase in  $N_2O$  was the appearance of nitrogen gas ( $N_2$ ). This increased in amount sufficient to account for 83-95 percent of the added tagged nitrate coincident with the reduction in amount and eventual disappearance of  $N_2O$ .

With the exception of NO, the environmental factors investigated did not change the kind or distribution of the gaseous products. The environmental factors affected only the length of time required for the added nitrate to be sequentially reduced to nitrogen gas.

Both free  $O_2$  from the circulating gas and combined oxygen from the added nitrate were used at the same time during the aerobic studies indicating that it is not necessary for the oxygen concentration in the atmosphere to be zero in order for gaseous loss of  $N_2O$  to occur.

The pathway of denitrification in soil is proposed as follows: 1) that nitrate is reduced to nitrite by microbial action, 2) that early in an incubation the nitrite accumulates and at a low pH, nitrous acid is formed and is in equilibrium with NO in the gaseous phase, 3) that  $N_2O$  begins to accumulate by reduction of nitrite and NO is reduced to  $N_2O$  by proceeding back through the suggested equilibrium system. Consequently, NO is not on the main pathway of the reduction of nitrate to nitrogen gas. The disappearance of NO from the gaseous phase does not signify a complete disappearance of the nitrite; rather, the reduction of nitrite to  $N_2O$  proceeds at such a rapid rate that NO ceases to accumulate in detectable amounts and proceeds to  $N_2O$  which accumulates, 4) that any intermediate product or products between nitrite and  $N_2O$  were of a transitory nature and did not accumulate, and 5) that when there is no longer nitrogen in an oxidation state higher than  $N_2O$ , the  $N_2O$  is reduced to  $N_2$ .

Microfilm \$2.50; Xerox \$4.80. 91 pages.

#### AN INVESTIGATION OF ACTIVE FRAGMENTS AND THE ACTIVE SITE OF SWEET POTATO $\beta$ -AMYLASE

(L. C. Card No. Mic 60-3398)

Rene Evard, Ph.D.  
Michigan State University, 1959

Major Professor: John C. Speck, Jr.

The reaction of sweet potato  $\beta$ -amylase with a number of proteolytic enzymes was investigated with the hope of producing active fragments. Isolation and characterization of the active fragments should provide valuable information concerning the nature of the amino acids at or near the active site, and lead to a mechanism of enzymatic catalysis for hydrolysis of acetal linkages.

Nevertheless, under ordinary conditions, sweet potato  $\beta$ -amylase is resistant to proteolysis catalyzed by trypsin, chymotrypsin, pepsin and subtilisin, as indicated by total retention of  $\beta$ -amylase activity and identical electrophoretic patterns before and after incubation with these proteases.

Papain appears to catalyze rapid hydrolysis of sweet potato  $\beta$ -amylase, but no active fragments could be detected in these mixtures by paper electrophoresis experiments. The action of carboxypeptidase on sweet potato  $\beta$ -amylase increases the activity of the latter.

Experiments were also conducted in urea solutions which could conceivably unfold the  $\beta$ -amylase molecule and render it more susceptible to proteolysis. No digestion occurred with trypsin or chymotrypsin under such

conditions; however, pepsin degraded the sweet potato  $\beta$ -amylase quite rapidly in 6 or 8 M urea solutions. The presence of active fragments in these mixtures could not be detected by paper electrophoresis experiments either.

Although active in 8 M urea solutions, sweet potato  $\beta$ -amylase was rapidly and irreversibly denatured, as shown by loss of activity and precipitation upon removal of the urea.

A complete amino acid analysis of sweet potato  $\beta$ -amylase indicated the presence of 10 to 11 cystine residues and 20 histidine residues per molecule. Aspartic and glutamic acids were present in the largest amounts. No tryptophan is present in sweet potato  $\beta$ -amylase.

The inhibition of sweet potato  $\beta$ -amylase was investigated with p-chloromercuribenzoate, iodoacetamide and N-ethylmaleimide. The fastest rate of inhibition was obtained with p-chloromercuribenzoate, and the slowest with iodoacetamide. The rate of inhibition by N-ethylmaleimide was intermediate. The inhibition of sweet potato  $\beta$ -amylase with N-ethylmaleimide was followed spectrophotometrically at 300 m $\mu$ . After reaction of one umole of N-ethylmaleimide with one sulfhydryl group of the enzyme the inactivation was complete. However N-ethylmaleimide still reacted with other sulfhydryl groups of the molecule.

Microfilm \$2.50; Xerox \$4.60. 86 pages.

#### THE ISOLATION, PURIFICATION, AND SOME PROPERTIES OF MAMMALIAN CYTOCHROME $\bar{b}$ .

(L. C. Card No. Mic 60-4232)

Donald Feldman, Ph.D.  
Rutgers University, 1960

Major Professor: Dr. W. W. Wainio

A method has been developed for the isolation of a soluble mammalian cytochrome  $\bar{b}$  of beef heart origin. Initial solubilization of the cytochrome  $\bar{b}$  component contained in an insoluble heart muscle preparation was achieved with successive extractions employing 0.6 and 0.8 percent sodium deoxycholate. The 0.6-0.8 percent fraction was then centrifuged at 168,380 X g in the Spinco Analytical Ultracentrifuge for 4 hours. A red gelatinous pellet was obtained which contained most of the cytochrome  $\bar{b}$  component of the original fraction.

The red pellet was insoluble in buffers and a variety of surface active agents. However, solubilization was achieved by digestion with phospholipase A (Eastern diamondback rattlesnake venom, *Crotalus adamanteus*) for 12-14 hours at 0-5°C, after an initial incubation for 2 hours at room temperature. A red precipitate was obtained after saturation to approximately 30 percent with ammonium sulfate. The absorption spectrum of this precipitate in 0.1M phosphate buffer at pH 7.4 showed maxima in the reduced form (dithionite) at 560-562, 530-532, and 428-430 m $\mu$ . However, there was an obvious contaminant absorbing at 553, 525, and 418 m $\mu$ . These bands correspond to those reported for cytochrome  $\bar{c}_1$ .

Ultracentrifugal studies of this preparation containing cytochrome  $\bar{b}$  and cytochrome  $\bar{c}_1$  indicated a single component with an uncorrected sedimentation constant of

13.9 x 10<sup>-13</sup> sec. The particle size of this preparation was estimated to be 350,000  $\pm$  50,000. Unsuccessful attempts to remove the cytochrome  $\bar{c}_1$  contaminant by ammonium sulfate fractionation, organic solvents or ultrasonic irradiation led to the conclusion that the cytochromes  $\bar{b}$  and  $\bar{c}_1$  might be combined as cytochrome  $\bar{b}-\bar{c}_1$  "particle."

Successful removal of the 553 m $\mu$  component was accomplished by digestion of the soluble cytochrome  $\bar{b}-\bar{c}_1$  "particle" with a crude pancreatic protease at room temperature (2 hours) and subsequent precipitation at pH 7.4 with ammonium sulfate at approximately 20 percent of saturation. A bright red precipitate was obtained which could be dissolved in 0.1M phosphate buffer, pH 7.4. Spectral studies indicated absorption maxima in the reduced state at 560 to 562, 530 to 532, and 428 to 430 m $\mu$ . In the oxidized state a prominent peak was seen at 413 to 414 m $\mu$ . The 553 m $\mu$  component (cytochrome  $\bar{c}_1$ ) was found to be present in the supernatant fluid after ammonium sulfate precipitation.

This preparation could not be reduced with sodium succinate and showed no absorption at 553, 525 or 418 m $\mu$ . In addition, no succinic dehydrogenase or cytochrome oxidase activity could be detected. The cytochrome  $\bar{b}$  preparation at this stage still contained trace amounts of sodium deoxycholate and attempts to remove this component by dialysis led to denaturation.

The extinction coefficient  $\Delta E_{cm}^{1g/ml}$  of the best cytochrome  $\bar{b}$  preparation obtained was calculated for the maxima at 561 m $\mu$  (relative to the isosbestic point at 575 m $\mu$ ) and was found to be 132. Calculations based on extinction values indicate a particle size for this preparation of approximately 175,000. An absorption spectrum of the pyridine hemochromogen corresponded to that of pyridine-ferroprotoporphyrin IX. Preliminary determinations of the oxidation-reduction potential using a ferri-ferro oxalate system, gave values ranging from +60 mv to +78 mv.

Microfilm \$2.50; Xerox \$8.00. 171 pages.

#### OXYGENATION OF STEROIDS BY STRAINS OF THE GENUS RHIZOCTONIA

(L. C. Card No. Mic 60-4234)

George Greenspan, Ph.D.  
Rutgers University, 1960

Major Professor: Dr. Carl P. Schaffner

The ability of various species and strains of the genus *Rhizoctonia* (*Mycelia Sterilia*, Fungi Imperfecti) to oxygenate steroids was investigated. Transformations both old and new were determined.

The preparative scale fermentations were run in 2-liter flasks on a rotary shaker in order to obtain sufficient material for isolation and characterization. Extractions were performed with chloroform, chloroform: methanol, or with ethyl acetate. The separation of products was undertaken by means of silicic acid or Florisil column chromatography, or by use of the Craig countercurrent distribution apparatus. Oxygenations have been found to occur at positions C<sub>1</sub> $\beta$ -, C<sub>2</sub> $\beta$ -, C<sub>6</sub> $\beta$ -, C<sub>7</sub> $\xi$ -, C<sub>11</sub> $\alpha$ -, C<sub>11</sub> $\beta$ -, C<sub>11</sub>-keto, C<sub>15</sub> $\xi$ -, and C<sub>15</sub>-keto.



*Rhizoctonia* sp. NRRL 2573 transformed Compound S to the 11 $\alpha$ -hydroxy, 11 $\beta$ -hydroxy, and 11-keto derivatives, or epi-hydrocortisone, hydrocortisone, and cortisone, respectively. These results constitute a unique trio of oxygenations of a single steroid at one position in the same fermentation. *Rhizoctonia ferruginea* CBS converted Compound S into 1 $\beta$ -hydroxy S or 4-pregnene-1 $\beta$ , 17 $\alpha$ , 21-triol-3, 20-dione, a new compound, and into 2 $\beta$ -hydroxy-S or 4-pregnene-2 $\beta$ , 17 $\alpha$ , 21-triol-3, 20-dione. This species also altered 4-androstene-3, 17-dione into a probable dihydroxylated derivative. *Rhizoctonia* sp. fr. *Triticum vulgare* effected the transformation of Compound S to 2 $\beta$ -hydroxy S and to 6 $\beta$ -hydroxy S or 4-pregnene-6 $\beta$ , 17 $\alpha$ , 21-triol-3, 20-dione.

*Rhizoctonia solani* fr. *Gossypium* introduced hydroxyl groups into C<sub>2</sub> and C<sub>6</sub> of cortisone to yield structures tentatively designated as 2 $\beta$ -hydroxy E, a new compound, and 6 $\beta$ -hydroxy E, or 4-pregnene-2 $\beta$ , 17 $\alpha$ , 21-triol-3, 11, 20-trione and 4-pregnene-6 $\beta$ , 17 $\alpha$ , 21-triol-3, 11, 20-trione respectively. The culture also effected the conversion of progesterone to 4-pregnene-6 $\beta$ , 15 $\xi$ , 20 $\xi$ -triol-3-one and to a probable 4-pregnene-1 $\xi$ , 15 $\xi$ -diol-3, 20-dione (tentative), all new compounds. The transformation of Compound S led to the production of 1 $\xi$ -hydroxy S and 6 $\xi$ -hydroxy S. From corticosterone, there were obtained two unspecified polar products, neither of which was hydrocortisone.

*Rhizoctonia* sp. fr. apple converted Compound S into a 15 $\alpha$ -hydroxy derivative or 4-pregnene-15 $\alpha$ , 17 $\alpha$ , 21-triol-3, 20-dione, and a 7 $\xi$ -hydroxy derivative or 4-pregnene-7 $\xi$ , 17 $\alpha$ , 21-triol-3, 20-dione. Both assignments are tentative.

Several C<sub>21</sub> steroids and one C<sub>19</sub> steroid were transformed into more oxygenated products by strains of the genus *Rhizoctonia*. The range of oxygenation of the steroid molecule by these fungi has been shown to be very considerable. The results obtained indicate that it is not possible to predict the oxygenation that one culture can effect from the transformations obtained with a single steroid substrate.

Microfilm \$2.50; Xerox \$6.20. 130 pages.

#### FLUORESCENCE STUDIES OF DIHYDRODIPHOSPHOPYRIDINE NUCLEOTIDE BINDING BY RAT LIVER LACTIC DEHYDROGENASE

(L. C. Card No. Mic 60-3933)

Ernel Dean Ihnen, Ph.D.  
University of Illinois, 1960

1. The fluorescent characteristics of the rat liver LDH-DPNH complex were determined.
2. Observations were made which give a reasonable basis for considering the fluorometrically measured LDH-DPNH complex as identical with the enzymatically functional complex.
3. The fluorescence characteristics were used to determine the stoichiometry and dissociation constants of enzymatic DPNH and DPN<sup>+</sup> binding. 2 moles of nucleotide were bound per mole of enzyme.  $K_{DPNH}$  was found to be 0.3  $\mu$ M. at pH 7.2.  $K_{DPN}$  was found to be 72  $\mu$ M at the same pH.

4. The presence of lactate was found to have a definite effect on DPNH binding.

5. The DPN<sup>+</sup>CN<sup>-</sup> complex was found to be bound by the enzyme in the same manner as DPNH. DPN<sup>+</sup> plus either hydroxylamine or Na<sub>2</sub>S showed no fluorometrically measurable binding.

6. AMP and ADP were shown to displace DPNH from its binding site. Adenine and nicotinamide-containing portions of the DPNH molecule showed no measurable ability to do this.

7. Observations were made of an unknown compound, a supposed impurity of a commercial ADPR preparation, which becomes fluorescent only upon binding by the enzyme.

Microfilm \$2.50; Xerox \$6.20. 129 pages.

#### AN INVESTIGATION OF GROWTH, COPPER METABOLISM, AND IRON METABOLISM OF RATS FED HIGH LEVELS OF ZINC.

(L. C. Card No. Mic 60-3727)

Aden Combs Magee III, Ph.D.  
North Carolina State College, 1960

Supervisor: Gennard Matrone

Young rats were used to investigate the effect of zinc toxicity on growth, copper metabolism, and iron metabolism.

Results of the study indicate that the factor(s) in liver extract which alleviates subnormal growth of zinc-fed rats is primarily organic. There is an indication that this factor can be extracted from the liver extract with methanol. Certain vitamins may be a part of this factor.

There is an indication that zinc interferes with iron metabolism as well as with copper metabolism. High levels of dietary zinc were associated with a marked decrease in the liver iron level. Copper supplements had no beneficial effect on the liver iron level of zinc-fed rats; supplements of iron were associated with an increase in the liver iron level of zinc-fed rats. Both copper and iron supplements were required to restore the hemoglobin level of rats fed 0.75% zinc to normal. There was only a partial restoration of the lowered hemoglobin level when either of these minerals was added alone to the zinc diet.

Radioisotope data indicate that zinc decreases the utilization and increases the excretion of copper in the rat but has little effect on the absorption of copper. There is an indication that zinc interferes with the utilization of iron but not with absorption.

Microfilm \$2.50; Xerox \$5.20. 101 pages.

# STUDIES ON THE ISOLATION, PURIFICATION AND CHARACTERIZATION OF PLASMINOGEN FROM HUMAN PLASMA FRACTION III.

(L. C. Card No. Mic 60-3401)

Gerda Mootse, Ph.D.  
Michigan State University, 1959

Major Professor: H. A. Lillevik

Purification of the plasma enzymes, enzyme activators, and enzyme inhibitors should give material with which many fundamental questions can be answered. Therefore, methods that give only reliable and repeatable preparations have practical significance. Such was the object of this study.

The starting material used was Cohn's Fraction III obtained from human plasma which contains two known precursors of proteolytic enzymes, namely, plasminogen and prothrombin.

An extensive purification study prior to applying the method of Kline was carried out on Fraction III. Thereafter an improved modification of the Kline procedure was developed.

The initial purification consisted of the elimination of the two main components from the Fraction III, fibrinogen and lipid material. Fibrinogen was first extracted into phosphate buffer at pH 6.4, ionic strength = 0.05. Plasminogen was next dissolved from the remaining precipitate into 0.1 M acetate buffer of pH 4.6, leaving lipid material with the residue. Adjusting the solution to pH 7.4 precipitated plasminogen. This precipitate was now ready for final purification by a modified Kline procedure.

The principal change in the Kline method developed in this study was the fractionation of Solution A (modified) by ammonium sulfate. The precipitate obtained at 0.20 - 0.34 saturation gave the highest activity yet reported, i.e. 120-140 P.U./mg N with 30 - 40 per cent yield.

The high purity plasminogen appeared homogeneous according to ultracentrifuge sedimentation patterns, but various components showed up in electrophoretic patterns obtained by runs in glycine buffer at pH 2.1.

Caseinolytic, fibrinolytic and p-toluene-sulfonyl-L-arginine methyl ester esterolytic activity by the plasminogen preparation was found to be inhibited by cysteine. L-lysine ethyl and methyl ester activities were not inhibited by this agent.

The presumed importance of the -S-S- linkage in the plasminogen molecule is indicated. Cysteine inhibition is suggested to be the result of reduction of -S-S- bond(s) or a disulfide interchange reaction in presence of thiol compounds.

Microfilm \$2.50; Xerox \$4.80. 94 pages.

# A STUDY OF ACIDIC AMINO SUGARS IN RELATION TO BACTERIAL CELL WALL SYNTHESIS

(L. C. Card No. Mic 60-3677)

Paul Joseph O'Brien, Ph.D.  
University of Pennsylvania, 1960

Supervisor: Dr. Friedrich W. Zilliken

In considering the possible biosynthetic precursors of N-acetyl-muramic acid a striking similarity was noted between the structures of this acid and of N-acetyl-neuraminic acid. They are both 9-carbon acids and are both condensation products of an N-acetyl-hexosamine and a 3-carbon acid. Before seriously considering an inter-conversion of these acids as a step in the biosynthesis of bacterial cell walls two questions had to be answered. First, it was necessary to find some evidence that N-acetyl-neuraminic acid occurred in a situation or structure which could be considered as a cell wall precursor. Second, the configurations of the two acids had to be elucidated beyond doubt.

To investigate the first question the extracellular macromolecules elaborated by *Escherichia coli* K<sub>235</sub> L + O were fractionated by ion-exchange chromatography and analyzed by paper chromatography of their hydrolysis products. Barry and Goebel reported a homopolymer of N-acetyl-neuraminic acid in the culture filtrates of this organism. In this investigation N-acetyl-neuraminic acid was also found associated with peptides which had compositions similar to those found in the cell walls of Gram negative bacteria. Nucleotides, possibly uridine nucleotides, were also found associated with these peptides.

In partial answer to the second question, Comb and Roseman published convincing enzymatic evidence that N-acetyl-neuraminic acid was a derivative of mannosamine, whereas the synthetic work of Strange and Kent indicated that muramic acid, as obtained from strong acid hydrolysis of bacterial cell walls, was a glucosamine derivative. In order to rule out possible structural alterations during the isolation of muramic acid the biosynthesis of this acid from N-acetyl-D-glucosamine was studied. The microorganism employed was *Lactobacillus bifidus* var. *pennsylvanicus* which requires derivatives of N-acetyl-D-glucosamine as essential growth factors. The incorporation of a C<sup>14</sup> labelled methyl N-acetyl-D-glucosaminide was correlated with striking morphological changes which this organism exhibits when progressively deprived of the essential growth factors. The muramic acid of the cell wall was isolated and its specific activity compared with that of the original methyl glycoside.

The metabolic fate of a number of growth factors was studied chromatographically and colorimetrically.

The results indicated that the growth factors for this organism were cell wall precursors. From the labelled cells, muramic acid was isolated with as much as 60% of the specific activity of the growth factor. All the growth factors were found to be cleaved to free N-acetyl-glucosamine which was, in turn, phosphorylated. The primary product appeared to be N-acetyl-glucosamine-6-phosphate which was in equilibrium with the 1-phosphate. These steps lead into the biosynthetic pathway to N-acetyl muramic as proposed by Jack Strominger.

It appears that *Escherichia coli* K<sub>235</sub> L + O elaborates



into the culture medium nucleotide-activated derivatives of N-acetyl-neuraminic acid, perhaps even of peptides related to bacterial cell wall components. No precursor-product relationship between these peptides and bacterial cell walls was established. Furthermore, the configuration of the hexosamine moieties of N-acetyl-muramic acid and N-acetyl-neuraminic acid are epimeric about carbon 2. The necessary epimerization seems unlikely in view of the apparently direct incorporation of N-acetyl-D-glucosamine into N-acetyl-muramic acid.

Microfilm \$2.50; Xerox \$6.20. 129 pages.

**A STUDY OF SOME PHYSICOCHEMICAL PROPERTIES OF THE WATER SOLUBLE PROTEINS OF THE BOVINE EYE LENS, WITH THE DEVELOPMENT OF A CONVENIENT METHOD OF PRELIMINARY FRACTIONATION.**

(L. C. Card No. Mic 60-4786)

Ann Jane Perry, Ph.D.  
Northwestern University, 1960

A method of salt fractionation of the water soluble proteins of the bovine eye lens has been thoroughly studied. Fractions have been examined by moving boundary electrophoresis and by ultracentrifugation. Mobilities and relative compositions have been measured for each fraction. Sedimentation constants, partial specific volumes, relative viscosities, and coefficients of refractive index increment have been obtained for selected fractions.

Molecular weights and molecular dimensions were estimated for three components. For alpha-crystalline, the molecular weight for an elongated ellipsoid model was estimated to be 857,900. The molecular dimensions were calculated to be 30.84 Å for the minor axis and 265.3 Å for the major axis. Similar calculations for two other components showed one to have a molecular weight of 545,900 with a minor axis of 29.04 Å and a major axis of 182.9 Å, while the other had a molecular weight of 46,930 with a minor axis of 14.65 Å and a major axis of 63.01 Å.

Fractions were screened for proteolytic enzyme activity, and slight activity was found in seven samples. The activity seemed to correlate with the presence in the active fractions of the component having an average electrophoretic mobility of 4.97 in phosphate buffer, pH 7.7, ionic strength 0.2. The fraction for which the molecular weight was estimated as 545,900 showed relatively high enzyme activity.

Microfilm \$2.50; Xerox \$5.20. 101 pages.

**ISOLATION AND CHARACTERIZATION OF A PROTEIN FRACTION FROM THE FAT GLOBULE MEMBRANE OF RAW WHOLE MILK**

(L. C. Card No. Mic 60-3978)

Kolar Seshaiyer Ramachandran, Ph.D.  
University of Illinois, 1960

In order to facilitate the study of the behavior of the materials adsorbed on the fat globule in milk, a method was devised to isolate a membrane-protein fraction for further studies. Milk was separated at 34° C. so that cream with 30-35% fat was obtained. The cream was washed six times with three times its weight of deionized water with agitation for five minutes at 36.7-37.8° C. The washed cream was churned and the butter fat was removed by centrifugation at 40° C. The butter serum was centrifuged at 25,000 x g in a -6.7° C. cold room. An aqueous phase was obtained and concentrated to 25-50% solids in a rotor evaporator. The concentrated aqueous phase was treated twice with ethanol-ethyl ether in the cold and washed eight times with ethyl ether. The crude-membrane protein was dried, extracted with 0.02 M NaCl and centrifuged at 25,000 x g for 30 minutes in a -6.7° C. cold room. The supernatant was dialyzed and lyophilized. The membrane-protein fraction obtained was stored in a desiccator until used.

The isolation procedure is milder than the methods used previously and also yields a fraction which exhibits a single maximum when investigated electrophoretically at pH 8.6. Denaturation studies indicated that the material was not denatured during fractionation. The material is usually very rich (8780 units/Mg N) in phosphatase activity and possesses no xanthine oxidase activity. Elemental analysis showed that the material has the following composition: C = 53.21-53.77%; H = 7.31-7.80%; N = 11.58-11.87%; P = 0.00-0.78%; S = 0.62-0.93%; ash = 2.79-4.12%; and O = 24.11-25.85%. The copper content of the material varied between 12-1280 ppm. The only other metal ions detected in the protein in significant amounts were sodium and magnesium.

Electrophoretic analysis showed that there were three components on the acid side of the isoelectric point (pH 1.8 and 3.5), two at pH 6.9 and single maxima at pH 8.6 and 12.0. Sedimentation studies supported these observations. The material showed a single maximum at pH 8.6 and 12.0 in sedimentation studies. The diffusion constants were determined and the molecular weights were calculated to be 449,000 at pH 12.0 and 1° C. and 1,045,000 at pH 8.6 and 1° C. The molecular weights were not calculated at pH 1.8 and 6.9 as the diffusion constants obtained were the weight average diffusion constants.

A comparison of the chemical and physical properties of the protein with other milk proteins indicated that the protein fraction was different from all the other known proteins in milk.

Microfilm \$2.50; Xerox \$4.20. 79 pages.

THE INTERACTION OF PHOSPHOLIPIDS WITH  
CYTOCHROME c AND CYTOCHROME c OXIDASE

(L. C. Card No. Mic 60-4250)

Melvin Reich, Ph.D.  
Rutgers University, 1960

Major Professor: Dr. Walter W. Wainio

The role of phospholipids as cofactors in the oxidation of ferrocytochrome c by cytochrome c oxidase has been studied by means of a cytochrome c-phospholipid complex.

Cytochrome c and a total mitochondrial lipid extract, both obtained from beef heart, combine between pH 2-5 to form an insoluble complex. Fractionation of the total lipid by silicic acid column chromatography indicates that the active component which is precipitated (40 per cent of the total phosphorus) is mainly phosphatidylethanolamine. A similar complex is formed with egg phosphatidylethanolamine giving a phospholipid-protein gram ratio of 5.6 to 1 at pH 5.0. This corresponds to the binding of ninety-five molecules of phosphatidylethanolamine per molecule of cytochrome c. Lecithin does not form such a precipitable complex.

The complex is readily soluble in acids, bases, organic solvents, and in aqueous solutions of the bile salts, sodium deoxycholate and sodium cholate, but not sodium dehydrocholate. The presence of one electrophoretic and sedimentation component following solubilization of the total mitochondrial lipid-cytochrome c complex suggests the formation of a cytochrome c-sodium deoxycholate-phospholipid complex.

Equilibrium dialysis studies reveal that the maximum number of sodium deoxycholate molecules which can be bound by phosphatidylethanolamine at pH 8.6 is 4. This is equal to the number of bile salt molecules required for the complete solubilization of one molecule of phospholipid in the complex.

Extraction of the dried complex with heptane results in the formation of a lipid-soluble cytochrome c. Treatment of the complex with 2-pentanone releases water-soluble cytochrome c whose absorption spectrum, electrophoretic mobility, and enzymatic activity are the same as that of the untreated material.

The ability of phospholipids to restore the activity of a phospholipid-free cytochrome c oxidase preparation prepared with bile salts has been determined. Phosphatidylethanolamine, phosphatidylserine, and inositol phosphate were most effective when the reactivating ability is expressed as the amount required for half-maximal velocity. The enzymatic activity is diminished after a solution containing cytochrome c and phospholipid is lyophilized, or heated, or frozen and thawed, or incubated with snake venom phospholipase A or treated with salmine or heparin. At the pH of the enzyme assay the cytochrome c-phospholipid complex remains in solution. Coenzyme Q ( $Q_{275}$ ) was ineffective in restoring enzymatic activity to the inactive preparation.

The visible absorption spectra of the deoxycholate-solubilized complex and that of the cytochrome c-phospholipid solutions are identical to that of untreated cytochrome c.

Sodium deoxycholate is a competitive inhibitor of the cytochrome c oxidase reaction. It is believed to compete with the added phospholipid for the cytochrome c, thereby

preventing the formation of or causing the disruption of the complex by removing or displacing the phospholipid moiety.

The activity of an already active cytochrome c oxidase preparation is also inhibited by sodium deoxycholate and sodium cholate, but not by sodium dehydrocholate which does not solubilize the cytochrome c-phospholipid complex.

Phospholipids are believed to act as cofactors in the oxidation of ferrocytochrome c by cytochrome c oxidase by combining with the substrate to form a complex. The phospholipid may act to maintain the substrate and enzyme in some essential spatial configuration. Chemical and physical agents which cause the removal or displacement of the phospholipid cause a reduction in cytochrome c oxidase activity.

Microfilm \$3.05; Xerox \$10.80. 236 pages.

A STUDY OF THE ENZYMATIC MECHANISM  
RESPONSIBLE FOR THE HEPATIC AND  
RENAL EXCRETION OF CERTAIN CARBOXYLIC  
AND SULFONIC ACIDS

(L. C. Card No. Mic 60-3480)

Orland Bruce Reynolds, Ph.D.  
Boston University Graduate School, 1960

Major Professor: Dr. F. Marott Sinex

The renal tubules and the liver are capable of excreting a variety of organic acids against high concentration gradients. The hepatic and renal groups of excreted compounds are not identical, though they are chemically very closely related. Some of the compounds are excreted by both organs. The substances excreted by either organ include carboxylic acids, sulfonic acids and sulfate esters. Some of the compounds under consideration are:

Substances used to test for kidney or liver excretory function:

p-aminohippuric acid (PAH), phenol red, brom-sulfalein, Rose Bengal.

Certain conjugates:

hippuric acid, glycocholic acid, taurocholic acid, bilirubin diglucuronide.

Urographic and cholecystographic agents:

Diodrast, Skiodan, Cholografin, Priodax.

The intimate manner in which the compounds excreted by either organ compete with each other for excretion has indicated to many workers that they are all excreted by the same mechanism. The close resemblance of hepatic and renal groups indicates the probability that the same basic excretion mechanism is involved in either organ, differing only in details of enzyme specificity. The high concentration gradients attainable suggest that high-energy intermediates are involved in the excretion of these acids.

Since many of the excreted compounds are sulfate derivatives, the possibility of the involvement of the sulfate-activating system in these excretion mechanisms



was tested in the experimental work of this thesis. This work was done with liver, since the reactions of sulfate activation have been characterized better in this organ than in kidney. (Lipmann: *Science*, 128: 575, 1958). The results may therefore be considered to apply directly only to the hepatic excretion mechanism. The assumption tested was that the excretion of these compounds involves their activation by the same enzymatic system (specifically involving ATP-sulfurylase) which activates sulfate in the reaction sequence of sulfate esterification. The compounds excreted by the liver, as presumed alternate substrates of ATP-sulfurylase, would thereby be expected to be inhibitory to sulfate esterification.

The enzyme preparation was made by 100,000 X g ultracentrifugation of a lamb liver homogenate (Hilz and Lipmann: *Proc. Natl. Acad. Sci. U. S.*, 41: 880, 1955). About 40 different compounds were tested for their ability to inhibit the sulfate esterification of p-nitrophenol in a system containing enzyme, magnesium ion, ATP, sulfate and p-nitrophenol in imidazole buffer. Among the compounds tested, a close relationship was found between the extent to which a compound is excreted by the liver and the inhibitory effect of the compound in a sulfate-esterification system. Compounds excreted primarily by the kidney tubules were not very inhibitory in this liver enzyme system; although those also excreted by the liver were moderately good inhibitors. These results were generally confirmed and the inhibitory effects localized to the ATP-sulfurylase step by the use of a similar system in which molybdate, rather than sulfate, was employed as an alternate substrate for this enzyme (Wilson and Bandurski: *J. Biol. Chem.*, 233: 975, 1958). These data indicate that ATP-sulfurylase is directly involved in the hepatic excretion mechanism for these compounds. The selectivity of the excretion system for different acids is apparently mediated principally by this enzyme, and competition between excreted substances represents a competition for this enzyme.

By analogy with the known reactions of sulfate activation, the structures of the intracellular intermediates of this hepatic excretion process may with reasonable certainty be predicted to be PAP-containing compounds (PAP is adenosine-3', 5'-diphosphate). It is reasonable to expect that this information will be very helpful in efforts to define this system more firmly by isolation and identification of such intermediates.

Similar derivatives, containing adenylic acid, have been suggested or investigated for their involvement in renal tubular excretion by Taggart and by Kellerman.

Microfilm \$3.25; Xerox \$11.25. 250 pages.

#### A COMPARISON OF THE BUTANOL AND COLD STORAGE LESIONS IN ERYTHROCYTES OF MAN AND RABBIT

(L. C. Card No. Mic 60-4252)

Roy Koechlein Rinehart, Ph.D.  
Rutgers University, 1960

Major Professor: Dr. James W. Green

The chemical lesion produced when mammalian red cells are exposed to n-butyl alcohol was compared to the

metabolic lesion of cold storage in both human and rabbit erythrocytes. The extent of the lesion produced was measured by the degree of cation reversal obtained. Treatment of the human and rabbit erythrocytes with 0.4 M butanol was performed at 10° C and 14° C respectively for a period of twenty minutes. The lower temperature of treatment for the human cells was found necessary if the cells were to survive a 24 hr. incubation period at 37° C. For comparison, aliquots of the original, untreated blood were cold stored for periods of 4 to 7 days to produce intracellular cation concentrations comparable to the butanol treated cells. These treatments resulted in a doubling of the intracellular Na level, and a loss of 20 to 25% of the intracellular potassium.

Recovery from these two types of lesions was determined by measurement of the ability of the cells to extrude Na from the cells and accumulate K from the medium. Glucose utilization rates and lactic acid production were also measured for the incubated cells. The recovery patterns for the treated cells were studied by incubating the cells as 10% suspensions in a sodium chloride-sodium phosphate buffer at pH 7.4 and 37° C for periods up to 24 hrs. As an energy source, adenosine (1.25 mM/liter susp.), glucose (11.1 mM/liter susp.), or a combination of adenosine plus glucose was added to each bottle of suspension being incubated.

The use of adenosine alone proved to be a satisfactory substitute for glucose for short periods with human cells, but was unsatisfactory for the rabbit cells. Glucose alone was satisfactory for the incubation media of both species, but the combination of glucose plus adenosine proved to be superior in most cases for the highest metabolic activity (glucose utilization and lactate production) and movement of cations against their concentration gradients.

The erythrocytes stored in the cold demonstrated a greater net ability to move cations than did the butanol treated cells. The lower net gain of K and extrusion of Na from the butanol cell is attributed to some damage to the plasma membrane by the alcohol. This damage is thought to take the form of small pores or channels in the membrane that lower the impermeability of the membrane to the extent that small ions such as Na and K may move by diffusion; but larger molecules such as hemoglobin are held back and hemolysis does not occur. The treated cells, both butanol and cold stored, utilize glucose and produce lactate in quantities comparable to fresh control cells, indicating that the treatments employed did not impair the glycolytic systems of red cells.

Microfilm \$2.50; Xerox \$6.60. 136 pages.

#### THE ACTION OF ASCORBIC ACID ON BETA-AMYLASE

(L. C. Card No. Mic 60-4255)

Arthur Wilson Rowe, Ph.D.  
Rutgers University, 1960

Major Professor: C. Edwin Weill

Ascorbic acid has been found to inhibit the hydrolysis of starch by  $\beta$ -amylase. This inhibitory effect of ascorbic acid has been shown to be the result of the reduction of

cupric ions in solution to cuprous ions which then bind to the enzyme and inactivate it. One part of cysteine can reverse the enzyme inhibition caused by 500 parts of ascorbic acid. The ascorbic acid inhibition of  $\beta$ -amylase was found to be non-competitive as compared to the competitive type of inhibition with para-chloromercuribenzoate (PCMB). There was no shift in the ultraviolet and infrared absorption peaks of  $\beta$ -amylase and ascorbic acid. There was no detectable oxidation of the essential tyrosine groups of the enzyme.

Inhibition of  $\beta$ -amylase was dependent upon the ascorbic acid oxidation. As the pH was increased the rate of oxidation of ascorbic acid and the inhibition increased. Any substance which prevented the oxidation of ascorbic acid will also decrease the inhibition. Sulfhydryl compounds such as cysteine were very effective in preventing both the ascorbic acid oxidation and enzyme inhibition. Antioxidants such as catechol, hydroquinone, and dihydrocaffeic acid were found ineffective in preventing the ascorbic acid oxidation and the enzyme inhibition. KCl was an effective inhibitor of ascorbic acid oxidation and also the corresponding enzyme inhibition. The KCl effect suggested the presence of copper ions in solution and analysis revealed the presence of minute traces of copper in the reaction mixture.

Ascorbic acid alone and added cupric ions alone had little effect in inactivating  $\beta$ -amylase while together they will completely inactivate the enzyme. The least concentration of copper necessary to cause appreciable inactivation of  $\beta$ -amylase with ascorbic acid was determined. Dialysis and ion exchange studies showed copper to be bound to the enzyme. Addition of fresh enzyme to copper-ascorbic acid-inactivated enzyme resulted in full recovery of the added enzyme. PCMB could be used to protect the enzyme from copper-ascorbic acid inactivation. The enzyme inactivation, previously thought irreversible, was found to be reversible on prolonged contact with cysteine. Morpholino hexose reductone and dialuric acid also inhibited  $\beta$ -amylase. Ascorbic acid acts through reduction of cupric ions to cuprous ions followed by formation of an inactive cuprous compound. Inorganic reducing agents such as  $\text{NaHSO}_3$  will also induce inactivation of the enzyme. The extent of inactivation caused by cuprous ions was similar to that caused by cupric ions plus ascorbic acid. The situation is reversed with mercury. Ascorbic acid decreases the extent of inhibition caused by mercuric ions by reducing the more potent inactivator, mercuric ions, to the less active mercurous ion.

A study of the sulfhydryl content of the enzyme showed approximately 14 sulfhydryls per enzyme molecule. Copper inactivation of the enzyme caused a decrease in the number of free sulfhydryl groups with corresponding activity loss. Various chelators, EDTA, diethyl dithiocarbamate, cuprizone, cuproine, and neocuproine will annul the ascorbic acid inhibition of  $\beta$ -amylase by complexing copper ions in solution. Sulfhydryl proteins such as bovine serum albumin, egg albumin, and  $\beta$ -amylase will retard the rate of oxidation of ascorbic acid by complexing copper ions in solution.

Ascorbic acid inactivates  $\beta$ -amylase by reducing cupric ions present in solution to cuprous ions with subsequent formation of a cuprous-mercaptide complex. There is no essential difference between the inhibition and so-called irreversible inactivation.

Microfilm \$2.50; Xerox \$5.60. 112 pages.

#### THE NATURE OF THE OCTADECADIENOIC AND OCTADECATRIENOIC ACIDS OF SUMMER BUTTER FAT

(L. C. Card No. Mic 60-4128)

Koritala Sambasivarao, Ph.D.  
The Ohio State University, 1960

Butter fat is one of the most complex of all the naturally occurring lipids. More than twenty-five different fatty acids have been isolated and identified. However, the exact chemical nature of the  $\text{C}_{18}$  polyenoic acids has not been well characterized. Even though the presence of geometrical isomers of linoleic acid in butter fat is generally agreed upon, the occurrence of linoleic acid itself has not been clearly established. The octadecatrienoic acid was identified as linolenic acid. One of the primary objectives of the present investigation was to establish the presence of linoleic acid in butter fat.

The methyl esters of two samples of summer butter fat were prepared. Saturated acid esters that are present in large quantities were first removed by low temperature crystallization, and the remaining unsaturated acid ester concentrates were fractionally distilled at low pressure to obtain the  $\text{C}_{18}$  methyl esters. Polyenoate concentrates were prepared from the  $\text{C}_{18}$  methyl esters by low temperature fractionation.

The polyenoate concentrates obtained by low temperature fractionation were separated by a chromatographic procedure on a silicic acid column. The results of ultraviolet and infrared methods of analysis of the different fractions obtained by chromatography indicated that 42 per cent of the octadecadienoate of one sample of butter fat and 30 per cent of the other had the trans configuration. The remainder of the dienoate should have an all-cis configuration, which suggests the possible presence of linoleic acid.

Silicic acid chromatography also revealed a small amount (3 to 5%) of saturated component in the polyenoate concentrates. By gas chromatography the saturated component was shown to consist primarily of a  $\text{C}_{17}$  branched-chain ester and a trace of a  $\text{C}_{15}$  ester. The presence of a  $\text{C}_{17}$  ester with one double bond was also indicated. Positive identification of these acids was hampered by the lack of reference compounds.

Highly concentrated fractions of dienoate and trienoate were prepared from the  $\text{C}_{18}$  polyene concentrates by chromatography. The chemical nature of these acids was established by bromination studies, by an alkali isomerization procedure, and by a lipoxidase enzyme method. About 65 per cent of all the non-conjugated dienoic acid in one concentrate and 73 per cent in the other was shown to be linoleic acid. Further linoleic acid was positively identified by isolating it as a tetrabromostearic acid which melted at  $115-116^\circ$ . A trans,trans isomer of linoleic acid was shown to be absent. Contrary to previous reports, only a small proportion of the isomers was found to consist of geometrical isomers of linoleic acid. A major proportion of the iso-linoleic acids was shown to consist of positional isomers whose double bonds are separated by more than one methylene group.

About 79 per cent and 71 per cent of the octadecatrienoic acid was found to be linolenic acid, the remainder probably consisting of geometrical isomers. Linolenic acid was identified by isolating it as the characteristic hexabromoderivative. Microfilm \$2.50; Xerox \$4.20. 79 pages.



ACTINOMYCIN BIOSYNTHESIS  
AND TRYPTOPHAN METABOLISM IN  
STREPTOMYCES ANTIBIOTICUS

(L. C. Card No. Mic 60-4260)

Andrew Sivak, Ph.D.  
Rutgers University, 1960

Major Professor: Dr. Edward Katz

The relationship of the tryptophan metabolite, 3-hydroxyanthranilic acid, to 3-hydroxy-4-methylanthranilic acid which could serve as a precursor to the phenoxazinone chromophore of actinomycin, prompted a study of the mechanism of tryptophan metabolism by Streptomyces antibioticus.

In growing cultures of the organism, cultivated in a chemically defined medium containing L-tryptophan, it was determined that kynurenine, anthranilic acid and 3-hydroxyanthranilic acid were formed. The conversion of L-tryptophan to kynurenine and anthranilic acid by a washed mycelium suspension was followed spectrophotometrically and by paper chromatography. The oxidation of tryptophan was shown to be stereospecific for the L-isomer and due to a constitutive enzyme on the basis of results obtained using adaptation techniques and Warburg experiments.

L-kynurenine was metabolized to 3-hydroxykynurenine and anthranilic acid by a mycelium suspension. In addition, a substance which was similar to kynurenine, but more acidic in nature, was found in reaction mixtures. A washed mycelium suspension of the organism metabolized 3-hydroxykynurenine to 3-hydroxyanthranilic acid.

The conversion of L-tryptophan to kynurenine was demonstrated using a cell-free preparation which was shown to have a requirement for peroxide activation. Kynureninase activity was also found in cell-free preparations employing kynurenine and 3-hydroxykynurenine as substrates.

On the basis of the evidence obtained, it was concluded that the primary pathway of tryptophan metabolism in S. antibioticus involved its oxidation to kynurenine followed by an oxidation to 3-hydroxykynurenine which was subsequently hydrolyzed to 3-hydroxyanthranilic acid.

The addition of tryptophan and its metabolites to growing cultures of the organism did not stimulate actinomycin synthesis, and in certain cases, especially at high concentrations (100 to 600  $\mu\text{g}$  per ml), inhibition of antibiotic production was noted suggesting that tryptophan may not be concerned with the biosynthesis of the actinomycin chromophore.

Using several tryptophan analogs,  $\alpha$ -, 4-, 5- and 6-methyl-DL-tryptophan, it was found that actinomycin synthesis was selectively inhibited by these compounds. No inhibition of growth was observed. The relative effectiveness of the inhibitors was  $\alpha$ ->4->5->6-methyl-DL-tryptophan. Inhibition of antibiotic formation could be demonstrated when 4-methyltryptophan was added at various times during the course of the fermentation. The inhibition due to the  $\alpha$ - and 4-methyl-DL-tryptophan was partially reversed by L-tryptophan and L-kynurenine. A slight reversal of the inhibition due to  $\alpha$ -methyl-DL-tryptophan was observed when 3-hydroxykynurenine and 3-hydroxyanthranilic acid were employed.

An inhibition of actinomycin synthesis by washed

mycelium suspensions was demonstrated employing the four methyl analogs of tryptophan. L-tryptophan and L-kynurenine were found to completely reverse the inhibition due to  $\alpha$ -methyl-DL-tryptophan; however, with 3-hydroxykynurenine and 3-hydroxyanthranilic acid, only a partial reversal of the inhibition of antibiotic formation occurred. The inhibitor studies showed that tryptophan metabolism was closely associated with actinomycin synthesis.

To determine whether tryptophan was involved in the formation of the actinomycin chromophore, 7 $\alpha$ -C<sup>14</sup>-DL-tryptophan was incorporated into a growing culture of S. antibioticus, and the actinomycin formed was isolated and crystallized to constant radioactivity. Determination of the specific activity of two chromophore derivatives, actinocinin and desaminoactinocylthreonine dimethyl ester, revealed that the chromophore had essentially the same specific activity as the intact molecule. This indicated that tryptophan was a precursor of the actinomycin chromophore, probably via 3-hydroxyanthranilic acid.

Employing C<sup>14</sup>H<sub>3</sub>-sodium acetate, the actinomycin chromophore was found to contain only 4 per cent of the activity of the intact molecule. A large portion of the radioactive label was in the proline residues of the peptide portion of the antibiotic. The data reveal that acetate was not a chromophore precursor.

The actinomycin chromophore, actinocinin, and the N-methyl amino acids, sarcosine and N-methylvaline, were found to contain radioactive label which was derived from C<sup>14</sup>H<sub>3</sub>-S-methionine.

Two metabolic products were isolated from a culture of the organism grown in the presence of D-valine. One substance was shown to be similar to actinocinin; the other material contained threonine, valine and a moiety responsible for the characteristic ultraviolet absorption spectrum of the substance.

Tryptophan metabolism and biogenesis of actinomycin in S. antibioticus are discussed.

Microfilm \$3.10; Xerox \$10.80. 237 pages.

A COMPARATIVE STUDY WITH  
S<sup>35</sup> METHIONINE IN NORMAL AND  
IN PROTEIN-DEPLETED RATS

(L. C. Card No. Mic 60-4265)

Samson Symchowicz, Ph.D.  
Rutgers University, 1960

Major Professor: Dr. James B. Allison

The changes in protein metabolism caused by depletion of protein stores were investigated in the rat. S<sup>35</sup>-labeled methionine was used to measure the concentration and the distribution of the radioactivity in serum at various time intervals, ranging from 10 minutes up to 72 hours after the intraperitoneal administration of the amino acid. During the initial period after administration of S<sup>35</sup>-labeled methionine, large amounts of unbound radioactive material were present, which is believed to consist predominantly of free methionine. Measurable amounts of the S<sup>35</sup> label incorporated into serum proteins appeared about 30 minutes after the injection of the amino acid. The peak of the

radioactivity in serum was attained about 8 hours after administration of the labeled material, and it was slightly higher in the normal than in the protein-depleted rat. After reaching the maximum value, the rate of disappearance of the label from the serum was faster in the normal rat. This caused a relative increase in the concentration of radioactivity in serum of protein-depleted rats, in the later part of the curve.

The distribution of the radioactive label in various fractions of serum protein was studied by paper electrophoresis. The results indicated a dependence of the distribution upon the nutritional state of the animal. Albumin appeared to be the major single carrier of radioactivity in the normal rat. The concentration of the  $S^{35}$  label in this fraction increased with time relative to other serum protein fractions. In the depleted rat, however, the  $\alpha$ -globulin was the major site for  $S^{35}$  incorporation. The relative amount of radioactivity associated with each protein fraction remained nearly constant throughout the period under investigation. The distribution of the  $S^{35}$  label in serum protein fractions was not affected by varying the degree of protein depletion, as long as the depletion did not exceed certain limits. Excessive depletion was marked by drastic changes in the distribution leading to a shift in the concentration of the label from the albumin into the  $\beta$ - and  $\gamma$ -globulin region.

There was no difference in the total concentration of the  $S^{35}$  label in serum after injection of DL- or L-methionine. There were, however, indications that the distribution of the  $S^{35}$  label may be slightly dependent upon the isomer used.

*In vitro* studies on the incorporation of methionine into serum protein did not indicate any presence of the  $S^{35}$  radioactivity in the serum protein, irrespective of the nutritional state and kind of diet fed to the rat.

Microfilm \$2.50; Xerox \$5.00. 100 pages.

#### THE BIOSYNTHESIS OF THE ACID MOIETY OF HYOSCYAMINE AND SCOPOLAMINE IN *DATURA STRAMONIUM* L.

(L. C. Card No. Mic 60-4666)

Edward Wesley Underhill, Ph.D.  
University of Rhode Island, 1960

An attempt has been made using  $C^{14}$ -labelled compounds to elucidate a biosynthetic pathway leading to the formation of tropic acid, a product of hydrolysis of the ester alkaloids hyoscyamine and scopolamine, in *Datura Stramonium* L. Three pathways were proposed for the biosynthesis of this aromatic branched-chain acid which, in summary, involved:

1. the condensation of acetate units to form an isoprenoid intermediate which might then be converted to tropic acid;
2. the reaction of shikimic acid with the alpha carbon of a three-carbon acid such as lactate or propionate;
3. the conversion of phenylalanine to phenylacetic acid followed by addition of an "active" 1-carbon unit such as formate or the beta carbon of serine to form the branched structure.

Certain hypothetical precursors, in the form of  $C^{14}$ -

labelled compounds, were administered via root absorption to *D. Stramonium* plants during their growth in hydroponic culture. The plants were allowed to metabolize the administered compounds for periods of seven and ten days respectively in the experiments which were carried out. Hyoscyamine and scopolamine were extracted from the plant material by conventional methods of alkaloid extraction, and their separation and purification were effected by countercurrent distribution and chromatography. The radioactivity of each alkaloid sample was determined. From these results the effectiveness of the administered compounds as precursors of the alkaloids was ascertained by calculating the dilution of the  $C^{14}$  isotope in the conversion of each administered precursor to the respective alkaloid. The extent of dilution has been assumed to be an expression of the utilization of that precursor in the biosynthesis of the alkaloids. Of the  $C^{14}$ -labelled compounds employed, phenylalanine-3- $C^{14}$ , phenylacetic acid-1- $C^{14}$  and sodium acetate-2- $C^{14}$  were the most efficient precursors of the alkaloids, followed by sodium propionate-2- $C^{14}$ , sodium formate- $C^{14}$  and serine-3- $C^{14}$  in that order; zinc lactate-2- $C^{14}$  proved to be a comparatively inefficient precursor of both hyoscyamine and scopolamine.

Those alkaloids possessing sufficient radioactivity were cleaved hydrolytically to yield either tropine or scopine and tropic acid. The hydrolysis products were separated and purified prior to the determination of their specific activities. The distribution of radioactivity which was present in the alkaloids proved to be entirely in their tropic acid moiety when phenylalanine-3- $C^{14}$  and phenylacetic acid-1- $C^{14}$  were used as precursors, and almost entirely in their tropine or scopine portions when sodium acetate-2- $C^{14}$ , sodium propionate-2- $C^{14}$ , sodium formate- $C^{14}$  and serine-3- $C^{14}$  were employed.

Those samples of tropic acid, obtained when phenylalanine-3- $C^{14}$  and phenylacetic acid-1- $C^{14}$  were used as precursors, were degraded to determine the location of the radioactivity within the tropic acid molecule. The results of these degradation studies showed that (1) the radioactivity in tropic acid was present in its phenyl carbons or in the carbon adjacent to this group when phenylalanine-3- $C^{14}$  was employed as precursor and (2) the  $C^{14}$  in tropic acid was not in the carbonyl group of this acid, as was expected when phenylacetic acid-1- $C^{14}$  was used, but is now believed to have been present in the hydroxymethyl group.

On the basis of the foregoing results, the first two of the original three hypotheses were rejected completely, while the third was substantiated in part; further, the results suggest that the branched-chain acid may be formed by direct incorporation of carbon dioxide into phenylacetic acid which, upon reduction of its carboxyl group to an alcohol, would form tropic acid.

Microfilm \$2.50; Xerox \$4.80. 91 pages.



THE INCORPORATION OF  $S^{35}$  FROM  
L-METHIONINE IN TUMOR-BEARING AND  
PROTEIN-DEPLETED RATS

(L. C. Card No. Mic 60-4267)

Robert W. Wannemacher, Jr., Ph.D.  
Rutgers University, 1960

Major Professor: Dr. James B. Allison

Previous data obtained in our laboratory indicated that when dogs or rats were fed a protein-free diet there was a loss of body nitrogen and logarithmic decrease in serum albumin. The injection of  $S^{35}$  L-methionine into protein-depleted dogs results in an increased incorporation of  $S^{35}$  into the serum proteins and this specific activity could be correlated with the body nitrogen loss. In tumor-bearing dogs, however, the injection of radioactive methionine produced an increased uptake by serum proteins even in the presence of normal serum albumin concentration.

The object of the present experiments was to determine the correlation between body nitrogen loss, serum albumin concentration, and specific activity of serum protein after the injection of  $S^{35}$  methionine to control, tumor-bearing, and depleted rats. A study was also made to determine the incorporation of  $S^{35}$  into various tissues with specific emphasis on changes in liver and tumor cellular particles and in serum proteins of rats under these treatments. In order to develop a better concept of protein synthesis in the different tissue under various physiological conditions, these findings were integrated into our current understanding of protein metabolism.

Rats were divided into three groups. One group was fed 18 per cent casein in a semi-synthetic diet, another was fed this same diet but received a transplantation of the Walker 256 carcinoma, and the third was fed a protein-free diet for ten days. Those fed the protein-free diet were depleted in protein reserves, which was accompanied by a reduction in plasma albumin. The Walker 256 carcinoma grew rapidly over a period of seventeen days, preventing a positive nitrogen balance and growth of normal tissues. The serum albumin was somewhat depleted although not markedly so in the tumor-bearing animals. The uptake of  $S^{35}$  from L-methionine following injection was much greater in the proteins in liver, kidney, and heart from tumor-bearing animals as compared to the same proteins from the controls. The uptake in these proteins, however, was greater in the protein-depleted than in either the tumor-bearing or control animals. The specific activity of mitochondria, microsomes, and all sap in the liver was also greater in the tumor-bearing and protein-depleted than in the control rats, while the nuclear proteins were similar in all three groups. The  $S^{35}$  activity in the serum proteins of tumor-bearing rats increased rapidly one-half hour after injection of the isotope and then fell as the activity in the tumor rose. This rise and fall in activity of serum proteins was not nearly so rapid in protein-depleted as in the tumor-bearing animals. The serum albumin of protein-depleted and tumor-bearing rats had a lower percentage of the total serum  $S^{35}$  activity as compared to the control rats. These results have been made a part of an hypothesis concerning protein synthesis in depleted and tumor-bearing animals.

Microfilm \$2.50; Xerox \$5.00. 96 pages.

FACTORS AFFECTING THE  
INTESTINAL ABSORPTION OF METHIONINE

(L. C. Card No. Mic 60-4271)

Sam Yankelowitz, Ph.D.  
Rutgers University, 1960

Major Professor: Dr. M. W. Taylor

Absorption of amino acids has been studied by the use of a surgically prepared Thiry-Vella fistula in the chicken in which a section of the intestine 4-5 cm. long at the level of the yolk stalk is excised from the tract, the ends exteriorized by the use of nylon cannulas, and the remainder of the tract resected. The technique involved the passage of an amino acid solution of known concentration through the loop and the collection and analysis of 10 ml. aliquots of the effluent. Improvements over the original procedure used in this laboratory include a new apparatus to control the temperature of the perfused solution at 41°C.; controlling the rate of flow of the solution within a much narrower range; and a new method of collecting the perfusate. These changes in method have decreased variations in results.

The amino acid, methionine, and its isomers has been used in the present experiments. Studies have been made to determine the effect on absorption of the rate of flow of the amino acid solution through the intestine. Absorption of both D- and L-methionine increases with a decrease in flow rate. At the slowest flow rate used the greatest amount of methionine is absorbed. With L-methionine, the intermediate perfusion rates of 1.0 - 1.4 and 1.5 - 2.4 show less absorption and the differences between the amounts absorbed are not significant. Absorption of D-methionine at flow rates above 1 ml./min. seems to decrease with an increase in perfusion rate, but a statistical difference cannot be shown. The amount of L-methionine absorbed is significantly greater than the amount of D-methionine, at flow rates between 0.5 - 2.4 ml./min. At the rates of 2.5 - 3.5 ml., differences between D- and L-methionine no longer exist.

The absorption of methionine increases with an increase in concentration. This has been studied at methionine concentrations of 10, 20, 40, 80 and 160 mg. % concentrations. For L-methionine, the amount absorbed increases linearly up to the highest concentration used. The absorption of D-methionine increases linearly, with the 160 mg. % level being out of line on the high side. In comparing the D- and L-isomers, statistical differences are seen throughout the range of concentrations used, with the L-isomer being absorbed at a higher rate. However, at the 160 mg. % level, no difference between the D- and L-isomers is seen and saturation of the tissues is believed to occur.

In plotting the above data of either flow rate or concentration on a time curve, it may be seen that absorption increases, then levels off to a steady rate, and finally, after about 50 minutes, decreases.

The effect of concentration on absorption of methionine has been used to calculate Michaelis-Menton constants. The constant for L-methionine is lower than that for D- when calculated during the initial period of increasing absorption. When calculated for the period of steady absorption, the constant for D-methionine decreases to equal that of the L-isomer.

The presence of other amino acids has been shown to markedly decrease absorption of methionine. Two mixtures of amino acids were used, one of four amino acids and one of nine, and both seem to affect absorption of methionine to approximately the same degree. Both 10 and 40 mg. % concentrations were used and it seems that at the higher concentration the more complex mixture has a greater inhibitory effect on absorption.

Analogues of methionine have been studied to determine if there is a correlation between absorption and structure. It is theorized that an amino group in the free state is necessary for active absorption of methionine to occur. Substitution of an ethyl group for a methyl group attached to the sulfur does not decrease absorption and, in fact, may increase it.

Microfilm \$2.50; Xerox \$4.60. 88 pages.

## CHEMISTRY, INORGANIC

### MONOMERS AND POLYMERS CONTAINING Si-O-As OR Sn-O-As LINKAGES

(L. C. Card No. Mic 60-3633)

Bertrand Leo Chamberland, Ph.D.  
University of Pennsylvania, 1960

Supervisor: Alan G. MacDiarmid

This investigation was carried out in order to prepare new monomeric and polymeric compounds containing either Si-O-As(III), Si-O-As(V) or Sn-O-As(V) linkages. A comparative study of their hydrolytic and thermal stability was also performed.

$[(C_6H_5)_3SiO]_3As$  was prepared by the interaction of  $AsCl_3$  with  $(C_6H_5)_3SiONa$  or with  $(C_6H_5)_3SiOH$  in the presence of  $NH_3$ . It was also prepared by the cohydrolysis of  $AsCl_3$  with  $(C_6H_5)_3SiCl$ .  $[(C_6H_5)_3SiO]_2AsC_6H_5$  was prepared by the interaction of  $C_6H_5AsI_2$  with  $(C_6H_5)_3SiONa$ . Preparation of  $[(C_6H_5)_3SiO]_3AsO$  was accomplished by the reaction of  $(C_6H_5)_3SiCl$  with either an excess or deficiency of  $KH_2AsO_4$  and also by the reaction of  $(C_6H_5)_3SiCl$  with  $Ag_3AsO_4$ .

A bi-cyclic compound,  $As[OSi(C_6H_5)_2O]_3As$ , was isolated by the cohydrolysis of  $AsCl_3$  with  $(C_6H_5)_2SiCl_2$  and also by the reaction of  $AsCl_3$  with  $(C_6H_5)_2Si(OH)_2$  in the presence of a hydrohalogen acceptor such as  $(C_2H_5)_3N$  or  $NH_3$ .

In an attempt to prepare a polymeric derivative by the cohydrolysis of  $C_6H_5SiCl_3$  with  $AsCl_3$ , a product of composition  $[(C_6H_5SiO_{1.5})_n(AsO_{1.5})]_x$  was formed.

The macro-molecular species,  $(HO)_2As(O)[OSi(C_6H_5)_2-OAs(O)(OH)]_2OH$ , was prepared by the interaction of  $(C_6H_5)_2SiCl_2$  with  $KH_2AsO_4$  at room temperature. This product slowly decomposed to give a material whose composition approached  $[OSi(C_6H_5)_2OAs(O)(OH)]_x$ .

The preparation of  $C_6H_5As[OSi(C_6H_5)_2O]_2AsC_6H_5$  was affected by the reaction of  $C_6H_5AsI_2$  with  $(C_6H_5)_2Si(OH)_2$  in the presence of  $NH_3$ , which was used as the hydrohalogen acceptor.

In several attempts to prepare a polymeric species of

composition  $[(C_6H_5)_3AsOSi(C_6H_5)_2O]_x$ , decomposition of the desired product occurred with the formation of  $(C_6H_5)_3As(OH)_2$  and a viscous product to which no structure was assigned.

The over-all hydrolytic and thermal properties of the Si-O-As(III) compounds indicate that this metalloid system has somewhat improved properties over those of the primarily covalent or ionic systems, (Si-O-M systems, where M is a non-metal or a metal respectively), which have been investigated in the past.

The Si-O-As(V) derivatives are less thermally and hydrolytically stable than the corresponding Si-O-As(III) compounds.

The infrared spectra of the new compounds were examined. Tentative assignments to the Si-O-As(III) vibrational frequency at  $880-890\text{ cm}^{-1}$  and to the Si-O-As(V) frequency at  $912\text{ cm}^{-1}$  were made.

Several Sn-O-As(V) derivatives were also prepared in this investigation. Silver cacodylate was treated with  $(CH_3)_2SnCl_2$  to yield  $(CH_3)_2Sn[OAs(O)(CH_3)_2]_2$  in a polar solvent. The reaction of  $(CH_3)_2SnCl_2$  with  $C_6H_5As(O)(OH)_2$  yielded  $(CH_3)_2Sn[OAs(O)(OH)C_6H_5]_2$ . The compound,  $(CH_3)_2SnO_2As(O)CH_3$ , was prepared by the reaction of  $(CH_3)_2SnCl_2$  with  $CH_3As(O)(ONa)_2$  in an aqueous medium. Dimethyltin arsenate,  $[(CH_3)_2Sn]_3[AsO_4]_2$ , was prepared by the action of  $Ag_3AsO_4$  on  $(CH_3)_2SnCl_2$  in a polar solvent.

The aryl derivative,  $[(C_6H_5)_3SnO]_2As(O)C_6H_5$ , was prepared by the interaction of  $(C_6H_5)_3SnCl$  with  $C_6H_5As(O)(OH)_2$  in the presence of  $NaOH$ .

Tris-(triphenyltin)arsenate,  $[(C_6H_5)_3SnO]_3AsO$ , was prepared by the reaction of  $(C_6H_5)_3SnCl$  with  $KH_2AsO_4$  at room temperature in a mixed polar medium.

The infrared spectra of the new Sn-O-As derivatives were investigated but no definite vibrational frequencies were assigned. Microfilm \$2.50; Xerox \$6.60. 136 pages.

## DIELECTRIC BEHAVIOR IN POLAR SOLVENTS

(L. C. Card No. Mic 60-3894)

Arthur Wallace Cordes, Ph.D.  
University of Illinois, 1960

The dielectric constants and densities of solutions of various non-polar and polar compounds in polar solvents have been determined. Nitrobenzene, chlorobenzene, and 1,1,1-trichloroethane were used as the polar solvents.

An expression has been obtained for the initial linear relationship between dielectric constant and volume fraction of solute which exists for dilute solutions in polar solvents. The derived expression is based on a model which considers a solute-solvent molecular pair as the effective solute.

The dielectric properties of the solute-solvent pair were evaluated by using an Onsager expression which had been modified for a dipolar material occupying an ellipsoidal cavity. The effective volume of the molecular pair occupying the ellipsoidal cavity was assumed to be the sum of the two molecular volumes. The electronic polarizability of the pair was taken as average of that quantity for the two molecules, weighted according to molar volumes. For non-polar solutes, the dipole moment of the



solvent molecule was assumed to be oriented along the intermolecular axis. The effective dipole moment of such a molecular pair was the sum of the solvent moment and the maximum moment induced in the solute.

For polar solutes, two different models were used for the calculation of the effective moment of the solute-solvent pair. In one case the two molecules were assumed to have rotation hindered only by the electrostatic interaction of the dipoles. In the other model it was assumed that the solvent dipole moment was oriented along the intermolecular axis, and the polar solute rotated within this field. For both models the average angular orientation of the two dipoles was obtained from a Boltzman-type averaging of the angles, employing the electrostatic energy function characteristic of two dipolar molecules. The effective moment of the solute-solvent pair was obtained by the vector addition of the two dipole moments using the average orientation angles.

With the above assumptions for the molecular pairs, and the known properties of the solvent and solute molecules, the effective shape factors for the cavity occupied by solvent and non-polar solutes could be obtained from experimental data. The shape factors obtained were reasonably linear functions of the partial molar volumes of the solutes for solutions of near-spherical, symmetrically polarizable solute molecules of approximately the same size as the solvent molecules. Solutions in which the solutes have marked anisotropic polarizability, non-spherical shape, and a partial molar volume greater than two times the volume of the solvent molecule were found to deviate markedly from the above relationship.

For the polar solutes the dipole moments were calculated using an estimated shape factor for each solute. These shape factors were estimated on the basis of the results for non-polar solutes. The dipole moment values obtained from the oriented dipole model were in good agreement with known values; the moments calculated from the free rotation model were too high in general.

This method of treating the dielectric properties of polar solutions should be of value in determining dipole moments in polar solvents, or in investigating intermolecular interactions in such media.

Microfilm \$2.50; Xerox \$6.00. 123 pages.

#### REACTIONS OF NITROGEN (II) OXIDE WITH AMINES

(L. C. Card No. Mic 60-3937)

Bruce Richard Karstetter, Ph.D.  
University of Illinois, 1960

The reactions of nitric oxide with a series of seventeen primary and secondary aliphatic amines have been studied at low temperatures and pressures varying from one to thirty atmospheres.

Many of the amines form compounds with nitric oxide which may be represented by the general formula,  $R_2NH_2^+ R_2N \cdot N_2O_2^-$ . These compounds are referred to as amine-nitric oxide addition compounds although they are actually the alkyl substituted ammonium ion salts of the amine-nitric oxide adducts ( $R_2NH \cdot N_2O_2$ ). These adducts are probably formed as intermediates but have

not been isolated. Many of the amine-nitric oxide addition compounds undergo a neutralization reaction with sodium ethoxide to produce the corresponding sodium salts  $Na^+ R_2N \cdot N_2O_2^-$ .

The stability of the amine-nitric oxide addition compounds varies over a wide range. With the exception of the isopropylamine and cyclohexylamine products, which decompose slowly, the nitric oxide addition compounds of the primary amines are very unstable at room temperature. The stability steadily increases in the series of addition compounds formed by the straight-chain, primary amines from methylamine through *n*-butylamine. The stability falls off sharply with the *n*-amylamine product. The stability of the nitric oxide addition compounds of the secondary amines is generally greater than that of the primary amine products. The stability steadily increases in the series of amine-nitric oxide addition compounds formed by the symmetrical, straight-chain, secondary amines from diethylamine through di-*n*-hexylamine. The final two members of the series (the di-*n*-amylamine and di-*n*-hexylamine products) are apparently stable indefinitely at room temperature. The sodium salts are generally more stable than the corresponding substituted ammonium ion salts, although the sodium salts of the primary amine products display explosive tendencies at elevated temperatures.

The observed stabilities of the amine-nitric oxide addition compounds are apparently determined by a wide variety of influences, including such factors as the basicity of the amines, inductive and steric effects, crystal lattice energies, and the volatility of the amines. These factors are discussed in detail.

With the exception of isopropylamine, the amines having carbon chains which are branched at the carbon atom attached to the amine nitrogen do not form stable addition compounds because of their more restrictive steric requirements.

Aniline reacts violently with nitric oxide at high pressure. After an initial attempt to prepare the aniline-nitric oxide addition compound resulted in a violent explosion, no further work was done with aromatic amines.

Infrared spectra are reported for as many of the amine-nitric oxide addition compounds and their sodium salts as possible. The spectra serve primarily as confirmatory evidence for the proposed structures of the addition compounds and sodium salts. Absorptions arising from the  $\text{>NH}_2^+$  and  $-\text{NH}_3^+$  of the substituted ammonium ions are present in the addition compounds, and absent in the sodium salts. Assignments have been made for the N-O stretch in all of the compounds, and for the N-H stretch and deformation vibrations in the anions of the primary amine compounds. Attempts to find correlations between the frequency shifts of absorptions arising from the anions and the stability of the addition compounds have been unsuccessful.

Nuclear magnetic resonance spectra of four of the symmetrical, straight-chain, secondary amine-nitric oxide addition compounds are reported. As in the case of the infrared spectra, the NMR spectra serve as confirmatory evidence for the proposed structures of the secondary amine-nitric oxide addition compounds.

The decomposition of the diethylamine-nitric oxide addition compound in the presence and absence of oxygen has been investigated. In the absence of oxygen, the

compound decomposes slowly to diethylamine and nitric oxide. In the presence of oxygen, it is slowly oxidized to diethylnitrosamine and diethylammonium nitrite.

Microfilm \$2.50; Xerox \$6.20. 129 pages.

#### THE SYNTHESIS OF POLYMERIC SUBSTANCES CONTAINING SILICON-PHOSPHORUS BONDS

(L. C. Card No. Mic 60-3600)

James Aloysius Marley, Jr., Ph.D.  
University of Pennsylvania, 1960

Supervisor: E. Charles Evers

The purpose of this research was an investigation into the synthesis and physical properties of compounds possessing a silicon to trivalent phosphorus linkage. Particular emphasis was placed on substances of this type which might be polymeric in nature.

The scope of our work employed three general types of reactions:

- 1) The metathesis of chlorosilanes and mono- and di-lithium hydrogen phosphide.
- 2) Dehydrohalogenation reactions involving both alkylsilyl chlorides and phosphine and substituted silanes and phosphorus halides.
- 3) The reaction of chlorosilanes with elemental phosphorus.

The reaction of methylchlorosilanes with mono- and di-lithium hydrogen phosphide provided the most satisfactory method of synthesis for forming silicon-phosphorus bonds. Bis-trimethylsilyl phosphine,  $((\text{CH}_3)_3\text{Si})_2\text{PH}$ , was prepared using this method by treating trimethylchlorosilane with lithium dihydrogen phosphide in an ethyl ether solvent. Both a vapor pressure equation and infrared spectrum were determined for this compound.

In order to obtain a difunctional P-Si compound that would be useful in polymer preparation, dimethyldichlorosilane was treated with  $\text{Li}_2\text{PH}$ . The resulting compound was identified as  $((\text{CH}_3)_2\text{Si})_3(\text{PH})_2\text{O}_2$ , a viscous, air and moisture sensitive material. The reaction appears to be a consequence of three distinct steps. These are: the elimination of  $\text{LiCl}$  between reactants, partial condensation by the elimination of phosphine, and attack upon the solvent, ethyl ether, resulting in the incorporation of oxygen into the molecule.

Both  $((\text{CH}_3)_2\text{Si})_3(\text{PH})_2\text{O}_2$  and  $((\text{CH}_3)_3\text{Si})_2\text{PH}$  react with diborane to form solid adducts. The protonic hydrogen on the phosphorus in each of these compounds is capable of being replaced by sodium in liquid ammonia, and the sodium salt in turn when treated with methyl iodide results in replacement of the sodium with a methyl group.

A series of reactions were carried out between  $(\text{CH}_3)_3\text{SiCl}$  and  $\text{PH}_3$  in the presence of triethylamine, which should serve to eliminate  $\text{HCl}$  from the reactants. Conditions for reaction included heating in sealed bulbs, refluxing of the reactants in a xylene solvent under pressure and the use of an  $\text{AlCl}_3$  catalyst. In all of the experiments most of the  $\text{PH}_3$  was recovered and no evidence of reaction was found. Silyl chloride was also treated with  $\text{PH}_3$  in the presence of triethylamine with similar results.

Other dehydrohalogenation reactions were attempted using trichlorosilane and phosphorus trichloride. In the absence of triethylamine, no evidence of reaction was obtained at  $145^\circ\text{C}$ . At  $425-525^\circ$ ,  $\text{HCl}$  and a mixture of  $\text{PCl}_3$  and  $\text{SiCl}_4$  were produced. However, in the presence of triethylamine a violent reaction occurred well below  $0^\circ$ . An orange solid, together with  $\text{SiCl}_4$  was formed. The solid appears to be a non-stoichiometric phosphorus-chlorine compound.

Experiments employing  $(\text{CH}_3)_3\text{SiCl}$  and phosphorus at temperatures up to  $430^\circ\text{C}$  produced only thermal decomposition. When silyl chloride and phosphorus were combined some evidence of reaction was noted. However, no compound containing a silicon-phosphorus bond could be isolated.

Some future studies in this field might include attempts to increase stability toward oxidation and hydrolysis by increasing the coordination number of phosphorus and by substitution of larger organic groups in place of the lower aliphatic radicals.

Microfilm \$2.50; Xerox \$4.00. 73 pages.

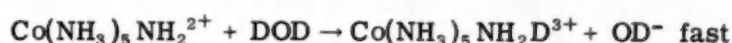
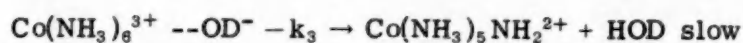
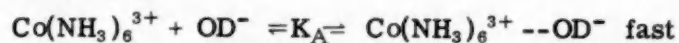
#### STUDIES OF HYDROGEN ISOTOPE EXCHANGE IN TRANSITION METAL AMMINE COMPLEXES

(L. C. Card No. Mic 60-4784)

Jay Ward Palmer, Ph.D.  
Northwestern University, 1960

The base catalyzed hydrogen exchange of metal ammine complexes in aqueous and heavy water solutions was investigated. The rates of hydrogen exchange in acetate buffer between various metal ammines containing hydrogen-1 and heavy water were determined by following the increase in  $\text{OH}^-$  concentration by measurements in the near infrared and by NMR. The rates of hydrogen exchange at various pH's between paramagnetic metal ammines, containing hydrogen-1 and light water were determined by measuring the transverse relaxation time by NMR of dilute aqueous solutions of these ions.

It was found that  $\text{OH}^-$  or  $\text{OD}^-$  catalyzed the hydrogen exchange of metal ammines. The mechanism of exchange may be as follows:



The rate expression for exchange would be

$$\text{rate} = K_A k_3 [\text{OD}^-]$$

where  $k_3$  is the slow step.

Alternatively, the explanation may be simply a large value of  $\beta$  in the Brønsted relationship

$$k_B = GK_B^\beta$$

between rate constant,  $k_B$ , and base dissociation constant,  $K_B$ . Evidence for general base catalysis was found in the ethylenediamine catalyzed proton exchange of  $\text{Cr}(\text{en})_3^{3+}$  and  $\text{D}_2\text{O}$  catalyzed proton exchange of  $\text{Pt}(\text{en})_2\text{Cl}_2^{2+}$ .



For a series of related metal ammines, the substitution of the central metal ion had a pronounced effect upon the rate of hydrogen exchange. It was speculated that the loss of crystal field stabilization energy of the complex in forming the amido transition state was in part largely responsible for the rate of exchange.

In all cases of octahedral coordination, the tris(ethylenediamine) complexes exchanged hydrogen faster than the corresponding hexammines. This was attributed to the smaller solvation energy of the ethylenediamine complexes. In square planar complexes where solvation is not as great, the hydrogen exchange rates were reversed.

The hydrogen exchange rates of a related series of complexes upon replacing ammonia ligands with other ligands appear to be influenced by the ability of the ligand to stabilize the transition state or to lower the activation energy. Two rates of hydrogen exchange were found with cis-dinitro ammonia and ethylenediamine cobalt(III) complexes, while only one rate was found for the corresponding trans-complexes.

For the hexamine and pentamine series of cobalt(III) complexes, the rate of hydrogen exchange increases with an increasing chelation and alkyl substitution. The effect of C-alkyl substitution upon rates of exchange was much smaller than N-alkyl substitution. Complexes containing both ammonia and ethylenediamine exchange hydrogen much faster than complexes containing only ammonia or ethylenediamine. The rates of hydrogen exchange of the chloropentamine cobalt(III) complexes are approximately  $10^5$  times faster than their rates of base hydrolysis. These results show that the base hydrolysis of these complexes may proceed by an  $S_N1CB$  mechanism.

The rate of exchange of the trans-ammine hydrogen of a series of  $Pt(dien)X^+$  complexes was found to correspond closely to the trans- effect of the X group.

Hydrogen exchange studies, by measuring the NMR transverse relaxation time of paramagnetic ammine complexes, compared favorably with studies done in buffered  $D_2O$ .

The  $pK_a$  of  $Ir(NH_3)_5H_2O^{3+}$  was found to be higher than those of the corresponding complexes of  $Rh^{3+}$  and  $Co^{3+}$ . This was in agreement with the relative hydrogen exchange rates of these complexes.

The rocking mode frequency infrared region, of the ammonia ligand in hexamine complexes may give an indirect measure of the strength of the N-H bond. An attempt was made to correlate this bond strength with hydrogen exchange rates.

Microfilm \$2.50; Xerox \$4.40. 84 pages.

OBSERVATIONS ON THE RARE EARTHS:  
STABILITIES OF  
DIETHYLENETRIAMINEPENTAACETIC  
ACID CHELATES.

(L. C. Card No. Mic 60-4004)

Larry Clark Thompson, Ph.D.  
University of Illinois, 1960

When the formation constants of rare-earth chelates are plotted against atomic number, it is found that there

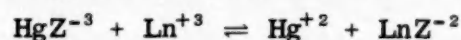
is always a discontinuity at gadolinium. On the basis of the observation that the partial molal entropy of the rare earth-EDTA chelates is a constant for the light rare-earth ions and another constant for the heavy rare-earth ions, this break at gadolinium has been explained for the EDTA chelates as being due to a change in the number of coordination positions occupied by the chelating agent.<sup>2</sup>

The purpose of this study was to determine accurately the formation constants of the rare earth-diethylenetriaminepentaacetic acid (DTPA) chelates as a function of temperature in order to obtain values for the thermodynamic functions and to evaluate the partial molal entropy of these complex ions.

At the time this investigation was begun, there were no data on the rare earth-DTPA chelates and it was necessary to determine the stoichiometry of the complexation reaction. Various mixtures of rare-earth ions and DTPA were titrated potentiometrically and it was determined that only a one to one chelate and a hydrogen chelate are formed.

The acid formation constants of the rare earth-hydrogen chelates were determined by a potentiometric titration of one to one mixtures of the rare-earth ions and DTPA. The log K values are very small, lying between 2.5 and 1.9 at an ionic strength of 0.1. These very low numbers indicate that the proton is associated with a carboxyl group rather than a nitrogen atom.

The formation constants for the rare earth-DTPA chelates were determined by using the mercury-indicator electrode<sup>4</sup> as applied to the equilibrium



where  $Z = DTPA^{-5}$  and  $Ln^{+3} = \text{rare-earth ion}$ . In this method the potential of an electrode sensitive to  $[Hg^{+2}]$  and the pH of the experimental solutions are measured. From the initial concentration and the stoichiometric equations, it is then possible to determine the formation constant for the rare-earth chelate provided that the formation constant for the mercury chelate is known. This can be determined in the same cell by omitting the rare-earth ion.

The log K values of the rare earth-DTPA chelates have values between 19.48 (La) and 22.82 (Dy) at an ionic strength of 0.1. When plotted against atomic number, these values give a curve having a break at gadolinium and a maximum at dysprosium. The log K value of the lutetium chelate has the lowest value among the heavy rare earths. These formation constants are thought to be more accurate than those previously reported.<sup>3</sup>

The data have been treated by a least squares analysis and the values of the thermodynamic functions obtained. The values so obtained have 95% confidence intervals which are too large to allow any definitive conclusions to be made about the partial molal entropies of the rare earth-DTPA chelates.

It has also been necessary to determine the values of the last three dissociation constants of DTPA as a function of temperature at an ionic strength of 0.1. This was accomplished by titrating the DTPA with carbonate-free potassium hydroxide under controlled conditions. The values of the dissociation constants at 20°C. agree well with the values in the literature.<sup>1</sup> The data were treated by a least squares analysis to obtain the values of the thermodynamic functions. These values indicate that in

DTPA the last two dissociation steps are more similar than are the corresponding steps for EDTA.

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Microfilm \$2.50; Xerox \$7.00. 148 pages.

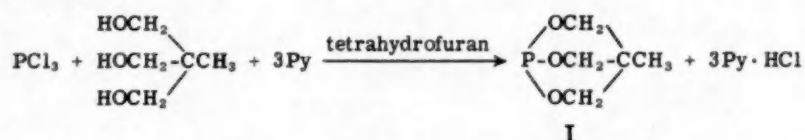
COMPOUNDS OF TRANSITION METALS  
WITH A PHOSPHITE ESTER

(L. C. Card No. Mic 60-4009)

John George Verkade, Ph.D.  
University of Illinois, 1960

Many phosphite esters have been prepared and characterized as well as some of their coordination compounds formed with salts of metals such as copper, silver, gold, platinum and mercury (1). It has also been found that attempts to prepare coordination compounds of salts of metals such as cobalt, iron, nickel, tin and lead with some of the lower trialkyl phosphites resulted only in intractable syrups (1).

In this research a ligand (I) (hereafter referred to as "phosph") having minimal steric hindrance and hence reduced ligand-ligand repulsion in the complex was designed. Phosph was synthesized (2) in 40% yield by the reaction:

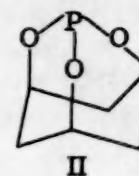


(where Py = pyridine).

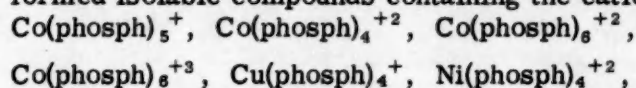
Phosph was oxidized to the phosphate by allowing it to react with hydrogen peroxide and the thiophosphate of phosph was formed when sulfur was allowed to react with phosph at 140°. The arsenic analogue of phosph was synthesized in a reaction analogous to the one shown above.

The molecular weights, dipole moments, infrared spectra and proton and phosphorus nuclear magnetic resonance spectra of these compounds were obtained. A comparison of the dipole moments of the bicyclic compounds with those of similar open-chain molecules reveals that the former are about double the latter. The fact that the phosphorus nmr absorption of phosph occurs at a lower field than that of triethylphosphite indicates a change in hybridization of the orbitals around the phosphorus in the bicyclic molecule.

Scale models reveal that the only other bicyclic phosphite reported (II) (3) is more strained and more bulky than phosph.



Coordination compounds of various transition metals with phosph were prepared by adding phosph to alcoholic solutions of metal salts. These were characterized by means of magnetic susceptibility measurements, conductivity studies, molecular weight determinations, infrared, ultraviolet and visible spectral studies, phosphorus nmr, microscopy and polarographic data. The metal ions formed isolable compounds containing the cations:



$\text{Ag(phosph)}_4^+$  and  $\text{Rh(phosph)}_4\text{Cl}_2^+$ . Platinum (II) and palladium (II) compounds containing two molecules of phosph per metal ion were also isolated. The first-row transition-metal coordination compounds of phosph in keeping with the low steric requirements of the ligand usually attain their maximum coordination numbers with only phosph in the first coordination sphere.

In ethanol, anhydrous cobaltous chloride and phosph react to form  $[\text{Co(phosph)}_4]\text{CoCl}_4$ . Magnetic measurements indicate that the structure of the  $\text{Co(phosph)}_4^{+2}$  ion is square-coplanar. Conductivity and spectral studies show that the anion is  $\text{CoCl}_4^-$ .

When cobaltous perchlorate hexahydrate is allowed to react with phosph in ethanol, disproportionation takes place and equimolar quantities of  $[\text{Co(phosph)}_5]\text{ClO}_4$  and  $[\text{Co(phosph)}_6](\text{ClO}_4)_3$  are formed. The ion  $\text{Co(phosph)}_5^+$  undoubtedly has a trigonalbipyramidal structure and employs  $\text{dsp}^3$  hybrid bonds.

Phosph exerts an unusually strong ligand field (even stronger than the cyanide ion) since the  $\text{Co(phosph)}_6^{+3}$  ion exhibits no visible nor near ultraviolet absorption bands. The structure is undoubtedly an undistorted octahedron.

Because of the minimal steric hindrance in phosph and hence the reduced ligand-ligand repulsion in the coordination compound, phosph is able to exert a much higher field than similar open-chain ligands. The symmetry of the ligand also favors crystallinity in its coordination compounds.

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Microfilm \$2.50; Xerox \$4.00. 74 pages.



I. A PHASE STUDY OF THE INDIUM  
BROMIDE-INDIUM TRIBROMIDE SYSTEM.  
II. A STUDY OF SOME CYANO COMPLEXES  
OF RHENIUM.

(L. C. Card No. Mic 60-4495)

Paul-Hermann Lawrence Walter, Ph.D.  
University of Kansas, 1960

I

While indium halides with stoichiometry  $\text{InX}_2$  have been reported in the literature for over eighty years, recent studies have shown that the dipositive state of indium is questionable. It has thus become necessary to first reinvestigate the indium-halogen systems to determine what compounds do exist, and second to offer an explanation for any "dihalide" which does appear.

Both the indium-iodine and indium-chlorine systems have been investigated by cryoscopic techniques. Although a compound with stoichiometry  $\text{InI}_2$  was found, no corresponding "dichloride" was observed. Rather, in this latter case, a "sesquichloride," with stoichiometry  $\text{In}_3\text{Cl}_3$ , was found. This anomaly was resolved by considering both compounds to be complex halides of indium(I) and indium(III). Thus,  $\text{InI}_2$  is represented as  $\text{In}^{\text{I}}(\text{In}^{\text{III}}\text{I}_4)$ , and  $\text{In}_2\text{Cl}_3$  as  $\text{In}_3^{\text{I}}(\text{In}^{\text{III}}\text{Cl}_6)$ .

This change in coordination number of indium can be correlated with the radius ratios of indium(III) ion to halide ion, using Pauling's radius ratio theory. In the case of indium-iodine, this ratio is 0.375 yielding the expected tetrahedral coordination, while with indium-chlorine, it is 0.447 permitting octahedral coordination. The proposed structures are consistent with this argument.

While both indium-chlorine and indium-iodine systems have been investigated, there still remained the indium-bromine system. That is the subject of this research. Here, the radius-ratio relationship helps little, for the ratio, indium(III)/bromide, is 0.415 and the theory is not sufficiently precise to enable one to predict the type of coordination in this case.

In the course of this research, a phase diagram of the indium monobromide-indium tribromide system was obtained by cryoscopic methods. In addition, the results were confirmed by X-ray powder patterns and by an extraction experiment. It was found that in addition to indium monobromide and indium tribromide, compounds having the empirical formulas  $\text{In}_2\text{Br}_3$ ,  $\text{InBr}_2$ , and  $\text{In}_4\text{Br}_7$  exist. The last compound has not been explained. However, in view of the earlier work on indium chlorides, it is postulated that the other two compounds are actually indium(I) hexabromoindate(III),  $\text{In}_3^{\text{I}}(\text{In}^{\text{III}}\text{Br}_6)$  and indium(I) tetrabromoindate(III),  $\text{In}^{\text{I}}(\text{In}^{\text{III}}\text{Br}_4)$ , respectively.

II

While six cyano complexes of rhenium have been reported, only two of these,  $\text{K}_5\text{Re}(\text{CN})_6$  and  $\text{K}_3\text{ReO}_2(\text{CN})_4$ , have been sufficiently studied to be considered definitely established. Since many of the previous workers used the dark colored mixture of potassium cyanide and potassium hexachlororhenate(IV) as the starting point for their research, it was decided to investigate both this mixture and any product which might be isolated from this mixture. The effect of potassium borohydride on the mixture and

the products obtained from it was also determined. All the reactions were carried out in aqueous medium.

In the course of this research, the following was accomplished:

1. There was isolated a gray solid, potassium tetracyanodioxorhenate(IV),  $\text{K}_3\text{ReO}_2(\text{CN})_4$ , from the black solution formed by mixing potassium hexachlororhenate(IV) and potassium cyanide.
2. There was prepared and isolated a new compound of rhenium(III), potassium tricyanotrihydroxorhenate(III),  $\text{K}_3\text{Re}(\text{OH})_3(\text{CN})_3$ , by reducing potassium tetracyanodioxorhenate(IV) with potassium borohydride.
3. It was shown that in the presence of chloride ion both the original mixture of potassium hexachlororhenate(IV) and potassium cyanide, and the isolated potassium tetracyanodioxorhenate(IV) are reduced to compounds of rhenium(I) by potassium borohydride. This may indicate that the chloride ion is acting as an electron-transfer agent.
4. It was demonstrated that potassium hexachlororhenate(IV) is itself merely hydrolyzed by aqueous potassium borohydride, forming hydrated rhenium(IV) oxide.
5. Evidence was found for a red complex of rhenium(IV) which is oxidized by molecular oxygen to a green complex in which the mean oxidation state of rhenium is five. This green complex is reversibly reduced back to the red by potassium borohydride.

From the results of this work, one can conclude that although cyanide ion stabilizes rhenium(I), chloride ion is essential to effect the reduction of potassium tetracyanodioxorhenate(IV) to rhenium(I). Also, the complexity of the ions formed in water solution indicates that non-aqueous solvents will probably be needed if one is to obtain completely cyanated complexes of rhenium (other than the hexacyanorhenate(I)).

Microfilm \$2.50; Xerox \$4.40. 85 pages.

MECHANISMS OF EXCHANGE REACTIONS  
OF RADIOCARBON MONOXIDE  
WITH METAL CARBONYLS

(L. C. Card No. Mic 60-4816)

Andrew Adalbert Wojcicki, Ph.D.  
Northwestern University, 1960

The kinetics of the exchange reactions of the simple and of substituted metal carbonyls with carbon-14 monoxide have been studied. The reactions were carried out in solution using a specially designed closed vessel, which was connected to a vacuum line. Rates of the exchange were followed by directly measuring the disappearance of radioactivity in the gaseous carbon monoxide above the solution. The counting was done through a thin-film window which was cemented to the vessel and kept in constant contact with the gas phase inside. An end-window Geiger-Muller tube, attached to a conventional scalar, was used to measure the radioactivity.

Of the simple metal carbonyls studied, only  $\text{Ni}(\text{CO})_4$  and  $\text{Co}_2(\text{CO})_8$  exchange at measurable rates at  $0^\circ\text{C}$ . With  $\text{Fe}(\text{CO})_5$ ,  $\text{Mn}_2(\text{CO})_{10}$ , and  $\text{Cr}(\text{CO})_6$ , no exchange was observed at room temperature over a period of three weeks. Mechanistic studies of the  $\text{Ni}(\text{CO})_4$  equilibration with  $^{14}\text{C}$  showed it to be independent of the latter's concentration and hence proceeding by a dissociative path. This mechanism of the exchange is quite reasonable in view of the absence of low energy orbitals on the nickel. Furthermore, a fast exchange with  $\text{Ni}(\text{CO})_4$  and a slow exchange with  $\text{Cr}(\text{CO})_6$  may be understood on the basis of relative metal-carbon bond strengths in these compounds.

With *t*-phosphine derivatives of  $\text{Ni}(\text{CO})_4$ , rates of the exchange decrease as the number of phosphine groups replacing the CO's increases. Thus the  $\text{Ni}(\text{CO})_3\text{P}(\text{C}_6\text{H}_5)_3$  exchange is more than five times slower than that of  $\text{Ni}(\text{CO})_4$ . Furthermore, the  $\text{Ni}(\text{CO})_2(\text{PR}_3)_2$  complexes were found to equilibrate extremely slowly at  $25^\circ\text{C}$ . This lability trend is explained in terms of the over-all bonding in tetrahedral complexes.

In  $\text{Co}_2(\text{CO})_8$ , all eight CO's were found to exchange at the same rate, via a dissociative path. The equilibration in the lactone derivative,  $\text{Co}_2(\text{CO})_8\text{C}_3\text{H}_7\text{C}\equiv\text{CH}$ , proceeds at a similar rate and with a similar activation energy. Two possible exchange pathways are suggested for these bridged compounds. In one mechanism, the rate determining step is the dissociation of a bridging CO at one of the two cobalt atoms; in the other, the rate determining step involves a homolytic cleavage of the Co-Co bond. The acetylenic derivative,  $\text{Co}_2(\text{CO})_8\text{C}_6\text{H}_5\text{C}\equiv\text{CC}_6\text{H}_5$ , which was found to equilibrate slowly, has no bridging CO's and hence cannot exchange by this path.

Of the cyclopentadienyl metal carbonyls investigated, only the  $(\text{C}_5\text{H}_5)_2\text{Ni}_2(\text{CO})_2$  and the  $\text{C}_5\text{H}_5\text{Co}(\text{CO})_2$  exchanges proceed at measurable rate at  $25^\circ\text{C}$ . These two reactions were found to depend on both, the carbonyl and carbon monoxide concentrations. In order to account for a bimolecular mechanism, it is suggested that two of the  $4p$  orbitals of the central metal are partially vacant and thus may be used for bonding in the transition state. A slow exchange with the other cyclopentadienyl metal carbonyls studied, namely  $(\text{C}_5\text{H}_5)_2\text{Fe}_2(\text{CO})_4$ ,  $\text{C}_5\text{H}_5\text{Mn}(\text{CO})_3$ ,  $(\text{C}_5\text{H}_5)_2\text{Mo}_2(\text{CO})_6$ , and  $\text{C}_5\text{H}_5\text{V}(\text{CO})_4$ , may be due to the steric hindrance around their respective metals.

The exchange of four of the five CO's in the  $\text{Mn}(\text{CO})_5\text{X}$  complexes was found to be independent of the CO concentration. The fifth CO equilibrates more slowly. The exchange of four CO's increases in the order:  $\text{Mn}(\text{CO})_5\text{I} < \text{Mn}(\text{CO})_5\text{Br} < \text{Mn}(\text{CO})_5\text{Cl}$ , the relative rates being in the ratio of 1 : 30 : 100, respectively. This variation in the lability may be explained by invoking the polarizability trend of the halide ions. A faster exchange of four CO's, as compared to that of the fifth one, may be due to a greater  $\pi$ -character of the latter Mn-C bond.

All of the "square planar" metal carbonyl halides studied exchange instantaneously, some even at  $-20^\circ\text{C}$ . An interesting example of a thermodynamically very stable but kinetically extremely labile compound was found in  $\text{Rh}[\text{P}(\text{C}_6\text{H}_5)_3]_2(\text{CO})\text{Cl}$ .

Microfilm \$2.50; Xerox \$6.00. 124 pages.

## CHEMISTRY, ORGANIC

### THE STEREOCHEMISTRY AND MECHANISM OF BASE-CATALYZED CONDENSATION REACTIONS

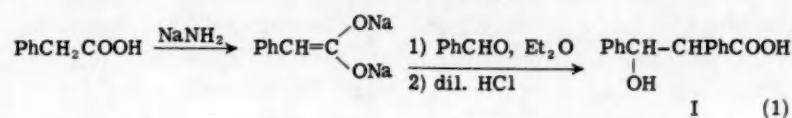
(L. C. Card No. Mic 60-4733)

Leo Ahramjian, Ph.D.  
Northwestern University, 1960

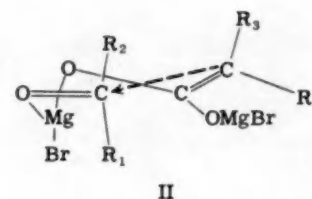
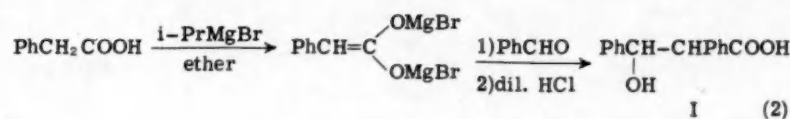
Supervisor: H. E. Zimmerman

#### PART I

The stereochemistry of aldolization reactions was studied. The condensation of phenylacetic acid and benzaldehyde with sodamide as the base (equation 1) yielded as the sole product the *threo* isomer of 2,3-diphenyl-3-hydroxypropionic acid (I).

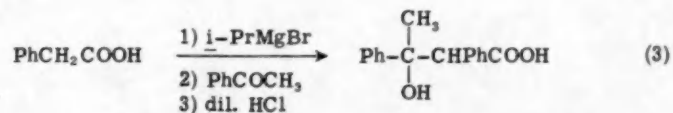


Previously,<sup>1</sup> the Ivanov condensation between phenylacetic acid and benzaldehyde (equation 2) had been shown to yield mainly the same *threo* acid (I), and a mechanism involving a six-membered ring transition state with the large groups oriented *trans* was proposed (II,  $\text{R}_1, \text{R}_3 = \text{Ph}$ ;  $\text{R}_2, \text{R}_4 = \text{H}$ ).



The observation that the sodium enediolate preferentially yields the same diastereomer as the magnesium enediolate is rationalized by assuming an intramolecular transfer of a sodium cation from the enolate to the alkoxide oxygen, the ion pairs being undissociated in ether solvent.

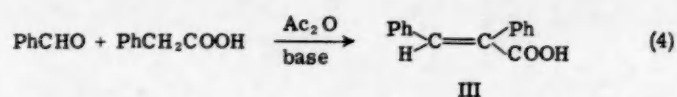
Also in accord with this six-membered ring transition state is the finding that the Ivanov reaction of acetophenone and phenylacetic acid (equation 3) afforded mainly (67%) the *F-threo* isomer ( $\text{Ph:Ph}$ ,  $\text{CH}_3:\text{H}$ ,  $\text{OH:COOH}$ ) of 2,3-diphenyl-3-hydroxybutyric acid.



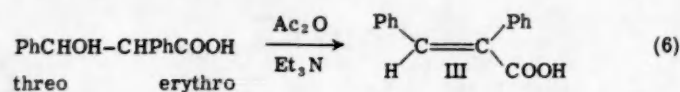
#### PART II

The Perkin condensation of benzaldehyde and phenylacetic acid had been known for quite some time to afford mainly the  $\alpha$ -phenylcinnamic acid stereoisomer with *cis*-phenyl groups (equation 5). Since both diastereomers of 2,3-diphenyl-3-hydroxypropionic acid intermediate were available from the Ivanov reaction (equation 2), a



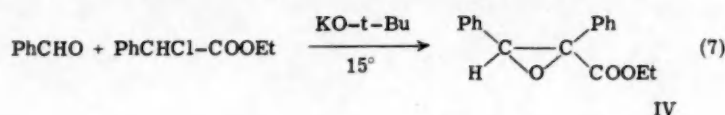


study of the behavior of each of these under Perkin conditions was undertaken. It was found that each isomer when treated with acetic anhydride:triethylamine under conditions where product isomerization was not a serious complication yielded  $98 \pm 2\%$  of the  $\alpha$ -phenylcinnamic acid with cis-phenyl groups (equation 6).



The Perkin condensation itself when carried out under these mild conditions afforded  $96 \pm 2\%$  of the same stereoisomer. Evidence was presented that the initial condensation step is not reversible and that the reaction stereochemistry is eliminatively controlled. The highly stereoselective formation of III is rationalized in terms of overlap control in the elimination transition state.<sup>2</sup>

In an earlier study,<sup>3</sup> it had been shown that the sole product from the Darzens condensation of benzaldehyde and ethyl  $\alpha$ -chlorophenylacetate was ethyl 2,3-cis-diphenyl-2,3-epoxypropionate (IV) equation 7). Both diastereomers of ethyl 2-chloro-3-hydroxy-2,3-diphenylpropionate were synthesized. Each intermediate when treated under Darzens conditions afforded the same



glycidic ester IV. Furthermore, it was demonstrated that each of the chlorohydrin intermediates rapidly reverts to benzaldehyde and ethyl  $\alpha$ -chlorophenylacetate as compared to the rate of cyclization to the glycidic ester. Evidence was obtained ruling out the possibility of a carbene mechanism.

These results are interpreted on the basis of a transition state in which the enhancement of the rate of cyclization results when the delocalizing carbonyl group is unhindered (overlap control).

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Microfilm \$2.50; Xerox \$5.60. 111 pages.

#### THE EFFECT OF RING SIZE ON FREE RADICAL ADDITIONS

(L. C. Card No. Mic 60-4663)

Bruce Arthur Bohm, Ph.D.  
University of Rhode Island, 1960

The relative reactivities of a series of methylenecycloalkanes having four, five, six, and seven members in the

ring have been determined by competition reactions with octene-1. Equimolar quantities of cyclic olefin and octene-1 were allowed to compete for a limited amount of hydrogen bromide under free radical conditions. The order of reactivity observed for this series of compounds is (5-ring, 6-ring, 7-ring) > 4-ring.

The results are discussed in terms of three factors which could influence the formation of the intermediate free radical: (1) steric factors, (2) changes in the coordination number of a ring carbon, and (3) electron availability. In line with the third point, a brief discussion is presented concerning the possibility of  $\pi$ -complex formation between the  $\pi$ -electron system of an olefin and a bromine atom.

Future work in the area of reactions of cyclic olefins is outlined.

Infrared spectra of the olefins used in this work and of the free radical addition products are included. The spectra of the cycloalkylideneacetonitriles with five, six, and seven carbons in the ring are also included.

The nuclear magnetic resonance spectra of the four methylenecycloalkanes used in this study are also included.

Microfilm \$2.50; Xerox \$4.40. 82 pages.

#### A KINETIC STUDY OF THE AMINOLYSIS OF METHYL AND ETHYL SALICYLATE

(L. C. Card No. Mic 60-3628)

George Lewis Brode, Jr., Ph.D.  
University of Pennsylvania, 1960

Supervisors: Dr. Allan R. Day and Dr. John G. Miller

The study of the aminolysis of several aryl esters was undertaken with several objectives in mind, (1) to study the effect of some different neighboring groups placed in the ortho position of an aryl ester; (2) to determine how alcohol produces its catalytic effect in ester aminolysis reactions; (3) to elucidate the mechanism(s) of the aminolysis of esters.

The esters chosen for the study were, (1) methyl salicylate, (2) ethyl salicylate, (3) methyl *o*-methoxybenzoate and (4) methyl benzoate. The four esters possess three different ortho substituents, hydrogen, hydroxyl and methoxyl. Methyl and ethyl salicylate contain a "built-in" alcohol function, while methyl *o*-methoxybenzoate contains a group with similar resonant and inductive forces while lacking the alcohol function. Methyl benzoate serves to illustrate the effect of the benzene ring while being devoid of both the resonant effect and "built-in" alcohol function. This series allows a comparison of the effects of hydrogen, hydroxy and methoxy, in the ortho position, on the aminolysis reaction. A further comparison between methyl salicylate and ethyl salicylate can also be made.

*n*-Butylamine was employed throughout the entire study as the aminolyzing compound. The solvents employed were benzene, dioxane, and alcohol, and various combinations of alcohol and benzene, and alcohol and dioxane.

A standard procedure for studying and following the reactions was employed. The reaction solution was prepared in a one-hundred ml. volumetric flask. After addition and mixing of all components the reaction solution was

transferred to a constant delivery, reservoir type, pipette from which ten ml. aliquots were measured into ten milliliters ampoules. The ampoules were then sealed, bound together with wire and placed in a constant temperature bath thermostated at 30.0°C. Periodically an ampoule was removed from the bath, broken open, and its contents transferred to a beaker containing a known amount of excess standard acid. The solution was back-titrated with standard base and from a knowledge of the initial concentration of amine and the concentration determined from the titration after a certain time interval, an evaluation of the extent of reaction could be made.

The experimental data for the aminolysis of the four aryl esters were examined to determine the relative reaction rates and kinetic order. The experimental observations can be summarized as follows:

- (1) The relative reactivities of the four aryl esters with n-butylamine are, methyl salicylate > ethyl salicylate > methyl o-methoxybenzoate > methyl benzoate.
- (2) Alcohol has a large catalytic effect on the aminolysis of methyl o-methoxybenzoate and methyl benzoate.
- (3) Alcohol produces an inhibiting effect on the aminolysis of methyl and ethyl salicylate up to certain concentrations. On exceeding these concentrations the alcohol displays a catalytic nature.
- (4) Amine is a catalyst in the reactions of methyl and ethyl salicylate. (Data was not available for testing in the cases of the other two esters).
- (5) The kinetics of the reactions studied in no case appear to follow the simple second or third order rate equation.

The relative reactivities of methyl and ethyl salicylate is in accord with the known fact that the reactivity of the ester depends on factors such as the electrophilic character of the carbonyl carbon atom and the steric arrangement of the atoms surrounding it. Both salicylates exist in an internally hydrogen bonded form producing increased positivity of the carbonyl carbon atom. For this reason they would be expected to exhibit a greater reactivity than the other two esters. The greater reactivity of the methoxy ester could be explained as resulting from either steric interaction of the methoxy group with the ester function with restricted resonance, or due to stabilization of the addition intermediate by an amine hydrogen-methoxy oxygen bond.

The catalytic effect of alcohol can be ascribed to alkoxide ion, carbonyl-oxygen alkoxyl-hydrogen bonding, and a dielectric constant effect.

The "inhibiting" effect found in the salicylates results from disruption of the chelate structure with a resulting decrease in the positivity of the carbonyl carbon atom. Continued addition of alcohol produces intermolecular hydrogen bonding between the alcohol and the carbonyl oxygen with resulting increase in the positive nature of the carbonyl carbon atom and a resulting increase in reactivity. Microfilm \$2.50; Xerox \$6.80. 144 pages.

## REACTIVITIES AND CONFIGURATIONS OF EPIMERIC SULFINIC ESTERS

(L. C. Card No. Mic 60-2684)

Carmen M. Cusano, Ph.D.  
Rensselaer Polytechnic Institute, 1960

Research Professor: Harry F. Herbrandson

The third-order rate constants for the epimerization of 1-menthyl 1-p-nitrobenzenesulfinate, 1-menthyl 1-p-iodobenzenesulfinate, and 1-menthyl d-p-iodobenzene-sulfinate by hydrogen chloride and tetraethylammonium chloride in nitrobenzene have been determined polarimetrically at 25.00 ± 0.05° to be 252 ± 4, 66 ± 5, and 66 ± 8 l.<sup>2</sup> mole<sup>-2</sup> sec.<sup>-1</sup>, respectively. Equilibration of the diastereoisomeric 1-menthyl esters indicate that 1-menthyl d-p-iodobenzenesulfinate is more stable than 1-menthyl 1-p-iodobenzenesulfinate by 215 ± 45 calories.

Second-order rate constants for the ethoxide ion catalyzed ethanolysis of the three sulfinic esters mentioned above have been measured polarimetrically at 25.00 ± 0.05°. The d-epimer was found to react faster than the 1-epimer by a factor of about two. The energies and entropies of activation calculated from rate data obtained at three different temperatures are 12.4 ± 0.7 kcal./mole and -18.1 ± 2.4 e.u. for the d-epimer but 12.1 ± 1.3 kcal./mole and -20.3 ± 4.2 e.u. for the 1-epimer.

The ultraviolet spectra of the two epimers show that the d-epimer is affected more by hydrogen bonding.

All these data have been interpreted as suggesting the existence of more non-bonded interactions in the 1-epimer than in the d-epimer. The relative merits of the two alternatives for the absolute configuration about the sulfur atom in these compounds are discussed.

1-Menthyl 1-p-iodobenzenesulfinate has been found to undergo aminolysis reactions only with extreme difficulty. Small yields of N-cyclohexyl p-iodobenzenesulfonamide have been obtained from the ester in two ways, however, and in both cases the resulting amide was optically inactive.

A simple and convenient laboratory preparation of dicyclohexylamine is reported by the reaction of cyclohexylamine with a catalytic amount of sodamide at elevated temperatures. This reaction may be applicable to the preparation of other secondary amines.

Microfilm \$2.50; Xerox \$6.00. 124 pages.



I. THE REACTION OF SOME HYDROPEROXIDES  
WITH OPTICALLY ACTIVE  
TRIALKYL PHOSPHITES.

II. ATTEMPTED SYNTHESSES OF  
CYCLOPROPANE HYDROPEROXIDE AND  
1-HYDROPEROXYBICYCLO-[2,2,1]-HEPTANE.  
III. THE SYNTHESIS AND DECOMPOSITION OF  
3,3,3-TRIPHENYLPROPANOYL PEROXIDE.

(L. C. Card No. Mic 60-4231)

Robert Lewis Ellsworth, Ph.D.  
Rutgers University, 1960

Major Professor: Donald B. Denney

Part I.

The reactions of optically active triisobornyl and tribornyl phosphites with racemic 3-hydroperoxy-3,5-dimethylhexane and 2-hydroperoxy-2-phenylbutane were investigated with the view toward obtaining a stereoselective process which would result in the formation of optically active alcohols and hydroperoxides.

Reaction of triisobornylphosphite ( $[\alpha]_D^{24} - 14.3^\circ$ ) with 3-hydroperoxy-3,5-dimethylhexane gave triisobornylphosphate ( $[\alpha]_D^{25} - 67.3^\circ$ ), optically inactive methylethylisobutylcarbinol, and unreacted hydroperoxide having zero rotation. The recovered hydroperoxide was catalytically reduced to yield inactive alcohol. Derivatives of the alcohols were prepared and shown to be inactive.

Similar results were obtained from the reaction of tribornylphosphite ( $[\alpha]_D^{25} + 3.15^\circ$ ) with 3-hydroperoxy-3,5-dimethylhexane.

Reaction of triisobornylphosphite with 3-hydroperoxy-3,5-dimethylhexane gave none of the expected products.

Part II.

An attempt was made to synthesize 1-hydroperoxybicyclo-[2,2,1]-heptane and cyclopropane hydroperoxide by oxidation of their corresponding organometallic compounds.

1-Bromobicyclo-[2,2,1]-heptane did not form the Grignard reagent.

Oxidation of 1-lithiumbicyclo-[2,2,1]-heptane gave only 1-norcamphanol.

Oxidation of the Grignard reagent from cyclopropylbromide gave an unidentified product. The material formed a 2,4-dinitrophenylhydrazone.

Part III.

The decomposition of 3,3,3-triphenylpropanoyl peroxide was investigated in carbon tetrachloride, in carbon tetrachloride in the presence of iodine, and in the absence of solvent. In all cases, the only products which were isolated were 1,1,2-triphenylethane, 1,1,2-triphenylethylene, 1,1,1,4,4,4-hexaphenylbutane, 3,3,3-triphenylpropanoic acid, phenyl  $\beta,\beta$ -diphenylacrylate, and carbon dioxide.

1,1,1,4,4,4-Hexaphenylbutane is a new compound. It was synthesized by an alternate route which involved the coupling of triphenylmethyl bromide and 3,3,3-triphenylpropyl iodide in the presence of magnesium.

Evidence is presented which indicates that the decomposition of 3,3,3-triphenylpropanoyl peroxide proceeds

predominantly by single bond breaking. It was suggested that this observation is a consequence of anchimeric acceleration of the homolytic bond cleavage by a neighboring phenyl ring.

Evidence is presented which points to the intermediate formation of an unrearranged 2,2,2-triphenylethyl radical. It was proposed that the 1,1,1,4,4,4-hexaphenylbutane arose from dimerization of two 2,2,2-triphenylethyl radicals which are simultaneously formed by the cleavage of three bonds. Microfilm \$2.50; Xerox \$4.80. 94 pages.

SOME EFFECTS OF MOLECULAR STRUCTURE  
ON THE PROPERTIES OF LINEAR POLYAMIDES

(L. C. Card No. Mic 60-4171)

Gabriel Michael Grudus, Jr., Ph.D.  
Purdue University, 1960

Major Professor: James H. Brewster

An attempt was made to assess the relative importance of the steric bulk, stereochemical and distributional randomness effects of side-chains in lowering the crystalline melting point of homo- and copolyamides derived from 7-aminoheptanoic acid, and a number of its 2-substituted derivatives. All homo- and copolymers prepared in this study yielded strong cold-drawable fibers. It was concluded from a comparison of the crystalline melting points of the fibers that the steric effect of twinned methyl groups is more effective in reducing the stability of the crystallites than the combined steric and stereochemical randomness effect of a single methyl group, which in turn is more effective than the distributional randomness effect. An increase in side-chain bulk from a methyl to an ethyl group was found to raise the crystalline melting point. The combined steric and stereochemical randomness of a group as large as a single phenyl group did not prevent fiber formation. The results obtained in this study are complicated by the fact that the homopolymers selected for this work are not isomorphous. The effects of changing crystallite structure appear to obscure the effects of molecular structure. Some suggestions have been made to explain this problem. It was also shown that the homopolymer derived from 5-oxa-7-aminoheptanoic acid is isomorphous with that derived from 7-aminoheptanoic acid. Microfilm \$2.50; Xerox \$5.80. 116 pages.

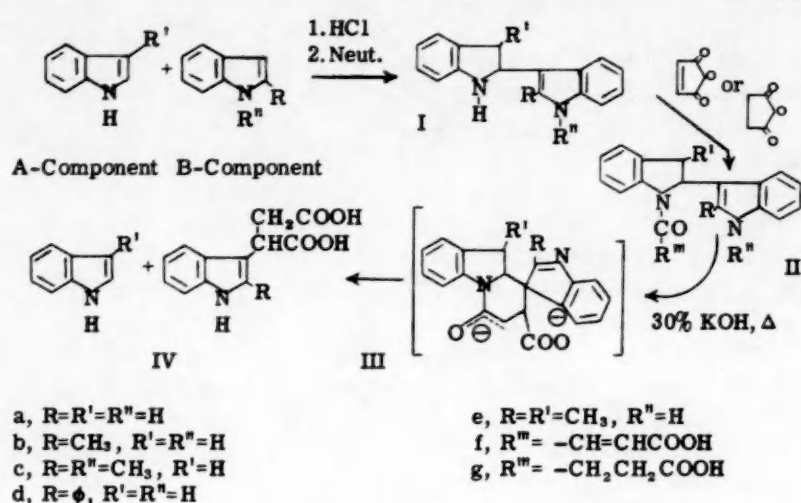
MIXED INDOLE DIMERS: SYNTHESIS AND  
A NOVEL REARRANGEMENT INVOLVING  
SOME OF THEIR DERIVATIVES.

(L. C. Card No. Mic 60-3553)

Charles F. Hammer, Ph.D.  
University of Minnesota, 1959

Adviser: Wayland E. Noland

The alkaline hydrolysis product of maleyldiindole (cis-IIaf) is (3-indole)-succinic acid (IVa), the result of an intramolecular rearrangement.



To test possible mechanisms for the rearrangement, it became necessary to label unambiguously one indole nucleus with respect to the other in an indole dimer. For this purpose, the first synthesis of mixed indole dimers and trimers has been developed. The mixed dimers are derived from an "A-component" (an indole having an open 2-position) and a "B-component" (an indole more nucleophilic than the "A-component"). Included are the dimers of indole with 2-methylindole (Ib), 1,2-dimethylindole (Ic), 2-phenylindole (Id) or 2,5-dimethylpyrrole and the dimer from skatole with 2-methylindole (Ie). Whereas acylation of diindole (Ia), indole:2-phenylindole dimer (Id) and indole:2,5-dimethylpyrrole dimer with maleic anhydride gave only the maleyl derivatives, the corresponding reactions with indole:2-methylindole dimer (Ib) and indole:1,2-dimethylindole dimer (Ic) gave not only the maleyl derivatives (cis-IIbf and cis-IIcf) but also lesser amounts of the fumaryl derivatives (trans-IIbf and trans-IIcf). Catalytic hydrogenation of the stereoisomeric maleyl and fumaryl derivatives gave the corresponding succinyl derivatives (IIbg and IIcg), which were also prepared independently by acylation of the mixed dimers with succinic anhydride.

The action of strong alkali on both the maleyl and fumaryl derivatives of indole:2-methylindole dimer gave (2-methyl-3-indole)-succinic acid (IVb), indicating to which nucleus the maleyl or fumaryl group had migrated. Similarly, the maleyl derivative of indole:2-phenylindole dimer gave (2-phenyl-3-indole)-succinic acid (IVd), which was prepared independently by the addition of 2-phenylindole to maleic acid.

During the reaction of maleic anhydride with skatole:2-methylindole dimer (Ie), there was obtained, in addition to the expected maleyl derivative, an isomer believed to have the structure of the proposed intermediate (IIIe plus H<sup>+</sup>). Both isomers rearrange to (2-methyl-3-indole)-succinic acid (IVb).

The citraconyl and itaconyl derivatives of indole:2-methylindole dimer both rearranged to the same diacid, C<sub>14</sub>H<sub>15</sub>NO<sub>4</sub>.

When the maleyl and fumaryl derivatives of indole:1,2-dimethylindole dimer (Ic) were hydrolyzed similarly with strong alkali, simple amide cleavage occurred, without rearrangement, to the dimer and fumaric acid; this shows the necessity of a hydrogen at position R'' in structure II. A mechanism is proposed (III) in which the maleyl or fumaryl group is transferred intramolecularly through a 6-membered, spiro ring intermediate from the 1-position of the indole nucleus to the 3-position of the indole nucleus of the dimer with subsequent depolymerization.

Surprisingly, hydrolysis of the maleyl derivative of indole:2,5-dimethylpyrrole dimer as well as itaconyldiindole did not result in rearrangement, but only in amide cleavage to the corresponding dimer.

During the preparation of the succinyl derivative of indole:2-methylindole dimer, a lesser amount of the succinyl derivative of a mixed trimer, diindole:2-methylindole trimer, was also isolated. Similarly, during the preparation of indole:1,2-dimethylindole dimer, smaller amounts of another mixed indole trimer, diindole:1,2-dimethylindole trimer (or its maleyl derivative) were also isolated. This trimer is different from the dimethyltriindole obtained by methylation of triindole. Evidence is presented that, contrary to a previous report, the latter dimethyltriindole is in reality an N,N-dimethylaniline derivative resulting from dimethylation of the primary amino group of triindole. A trimer corresponding to indole:di-2,5-dimethylpyrrole was also isolated during the preparation of indole:2,5-dimethylpyrrole dimer.

The competitive dimerization reaction of indole and 1-methylindole permitted isolation, after acylation with maleic anhydride, of only maleyldiindole. The competitive reaction of indole and skatole proceeded in a rather clear-cut stepwise fashion with formation first of diindole hydrochloride and then of diskatole hydrochloride. Corresponding to diskatole, the homodimer of 1,3-dimethylindole was also prepared. Microfilm \$2.50; Xerox \$7.00. 148 pages.

#### A STUDY OF THE ALKYLATION OF PYRRYLMETAL SALTS WITH BENZYL HALIDES

(L. C. Card No. Mic 60-4328)

Charles Floyd Hobbs, Ph.D.  
 University of Kansas, 1960

It generally has been conceded that the reaction of pyrrolmagnesium halides with alkyl halides affords carbon-alkylated pyrroles and that pyrrolsodium or pyrrolpotassium yields 1-alkylpyrroles. However, this generalization is not always true; for example, the reaction of pyrrolpotassium with allyl or crotyl bromide was shown to give 2-alkylpyrroles predominantly. In an attempt to gain an insight into the behavior of pyrrolmetal salts in alkylation reactions, the effect of reaction media, cation, and reaction temperature on the reaction of pyrrolmetal salts with benzyl halides was studied. Reactions were carried out under both heterogeneous and homogeneous conditions.

It was found that the products of the reaction were 1-benzylpyrrole, 2-benzylpyrrole, and dibenzylpyrroles. The latter were shown to be formed by further alkylation of 2-benzylpyrrole.

The ratio of 1-benzylpyrrole to 2-benzylpyrrole was increased by the use of more polar solvents, by a change from heterogeneous to homogeneous media, by use of lower concentrations of the pyrrolmetal salt, and by lower reaction temperatures. Alkylation at nitrogen also increased as the cation was varied in the order lithium < sodium < potassium < trimethylphenylammonium.

The substitution of benzyl bromide for benzyl chloride increased the yield of monobenzylated products, but did not affect appreciably the ratio of 1-benzylpyrrole to 2-benzylpyrrole.



It was shown that the monobenzylpyrroles do not rearrange under the reaction conditions.

The results are best explained on the basis of the degree of dissociation of the pyrrolmetal salt. It is proposed that the anion of the dissociated salt attacks the halide in a normal  $SN_2$  reaction, giving N-alkylpyrroles, and that carbon-alkylation occurs by reaction of the undissociated pyrrolmetal salt with the halide, possibly through a transition state in which the alkyl residue is adjacent to the  $\alpha$ -carbon of the pyrrole ring and the halide ion is adjacent to the cation. Thus, polar solvents would be expected to favor the dissociation of the salt and thereby, favor alkylation at nitrogen. Also, the degree of dissociation of pyrrolmetal salts should increase as the cation is varied from lithium to sodium to potassium to trimethylphenylammonium, and this is the order of increasing nitrogen-alkylation.

Since the polarity of the reaction media affects the alkylation ratio under homogeneous conditions as well as under heterogeneous conditions, and since dilution of the salt under homogeneous conditions favors nitrogen-benylation, the degree of homogeneity of the reaction media appears to have little or no importance in determining the position of alkylation.

It would be expected that the reaction of the undissociated salt with the halide would be a higher energy process than that of the dissociated salt. This was borne out by the experimental data. The yields of monobenzylpyrroles increased with increasing polarity of the medium and increasing size of the cation.

In addition, higher reaction temperatures should favor the higher energy process more than the lower energy process. The fact that the relative amount of 2-benzylpyrrole increased with increasing reaction temperature is consistent with this proposal.

Microfilm \$2.50; Xerox \$6.40. 133 pages.

#### REACTIONS OF 1-SUBSTITUTED NICOTINAMIDES AND REDUCTIONS BY DIHYDRONICOTINAMIDES

(L. C. Card No. Mic 60-3665)

John McNaughton Kolyer, Ph.D.  
University of Pennsylvania, 1960

Supervisor: Dr. D. C. Dittmer

The action of base on quaternary salts of nicotinamide was studied. When nicotinamide-1-benzylochloride was refluxed in sodium hydroxide solution, the products were ammonia, carbon dioxide, and benzylamine. This result is explained by ring-opening and hydrolysis. With cold sodium hydroxide solution, nicotinamide-1-benzylochloride gave the pseudobase dimolecular ether. Other dimolecular ethers, substituted on the benzyl group, were prepared similarly. Dissolution of the dimolecular ether in ethanol, or the reaction of nicotinamide-1-benzylochloride with base in dilute ethanol, gave a white, crystalline compound. This substance had the empirical formula of the pyridinium betaine which would result from the abstraction of a proton from the methylene group of nicotinamide-1-benzylchloride. However, the molecular weight was three times that

calculated for the betaine. Dry hydrogen chloride reconverted the compound to nicotinamide-1-benzylochloride. Reactions, physical properties, and absorption, fluorescence, and nuclear magnetic resonance spectra were consistent with a trimeric structure presumably resulting from the trimerization of the unstable, intermediate betaine. Probably the carbanion of one betaine molecule adds to the 4-position of the pyridinium ring of another molecule. This is a novel trimerization reaction of pyridinium compounds.

Adducts of thiols and 1-(2,6-dichlorobenzyl)-nicotinamide were prepared. These are "models" for the proposed adduct of DPN and the sulfhydryl group of an enzyme. The adduct with benzyl mercaptan reacted with malachite green to give the benzyl sulfide of malachite green and with hydrogen chloride to give the quaternary chloride. This adduct was found to be dissociated to the extent of 50% in 90% alcohol; the extent of dissociation in various dilutions of alcohol was studied by ultraviolet spectroscopy.

Attempts to reduce thiol esters to aldehydes by 1-benzyl-1,4-dihydronicotinamide were unsuccessful. However, the reduction of nitrobenzene, nitrosobenzene, and related compounds by dihydronicotinamides was observed. The reduction of nitrobenzenes is a model enzyme system for the enzyme-catalyzed reduction of nitrobenzenes by DPNH. The reaction of 1-benzyl-1,4-dihydronicotinamide and nitrobenzene gave aniline, phenylhydroxylamine, hydrazobenzene, nicotinamide, benzaldehyde (by hydrolysis), and traces of ammonia and carbon dioxide. Probably, the first step involves the formation of nitrosobenzene and the pyridinium hydroxide. Decomposition of the pyridinium hydroxide would give ammonia and carbon dioxide, and reaction of the pyridinium hydroxide with nitrosobenzene would give the nitron (hydrolyzed to benzaldehyde) and nicotinamide. Further reduction of nitrosobenzene by 1-benzyl-1,4-dihydronicotinamide gives aniline. Phenylhydroxylamine is an intermediate reduction product. Condensation of aniline and nitrosobenzene may give azobenzene, which is reduced by the dihydronicotinamide to hydrazobenzene. This reaction was subject to resonance and steric effects and was not hindered by the presence of hydroquinone. The amide group was not necessary, for nitrobenzene was reduced effectively by 1-benzyl-3-acetyl-1,4-dihydropyridine. A hydride-ion transfer mechanism is considered to be more likely than a free-radical mechanism. In the reduction of p-nitrosodimethylaniline, the nitron, corresponding to the nitron proposed in the reduction of nitrobenzene, was isolated. Aliphatic nitro compounds were not reduced to the amines.

Microfilm \$3.00; Xerox \$10.60. 232 pages.

#### AN INVESTIGATION OF THE THERMAL STABILITY OF POLYVINYLPHTHALATE SALTS

(L. C. Card No. Mic 60-4664)

Arthur Leo Laferriere, Ph.D.  
University of Rhode Island, 1960

The purpose of this investigation was to study the thermal behavior of the metallic salts of polyvinylphthalic acid.

The synthesis of 4-vinylphthalic acid was achieved starting with commercially available trimellitic anhydride. Since the monomer was soluble in water, it was polymerized in aqueous solution using a peroxydisulfate/hyposulfite redox catalyst system.

The thermal stability of these polysalts has been studied employing the techniques of thermogravimetry and differential thermal analysis. In thermogravimetric analysis, the polysalts were heated in an air atmosphere so that thermal decomposition was accompanied by oxidation. Atmosphere control was possible with differential thermal analysis so that oxidative effects were minimized.

The results of chemical and thermal analysis yielded evidence that the polysalts contain both physically adsorbed water and coordinated water. The evaluation of thermal stability showed that the alkaline earth metal polysalts were stable up to about 550° at which temperature decomposition became rapid.

Microfilm \$2.50; Xerox \$4.80. 94 pages.

#### PART I. THE PREPARATION OF 5,5-DIMETHYL-5-SILA-2-HYDROXYCYCLOHEPTANONE.

#### PART II. SUBSTITUENT EFFECTS IN AROMATIC SUBSTITUTION AS DETERMINED BY MERCURIDESILYLATION.

#### PART III. THE METALATION OF CUMENE.

(L. C. Card No. Mic 60-4186)

Thomas Vincent Liston, Ph.D.  
Purdue University, 1960

Major Professor: Dr. R. A. Benkeser

##### Part I.

This compound was prepared in a 40% yield by an acyloin ring closure of dimethyldi-(2-carbethoxyethyl)-silane.

##### Part II.

The rate constants for the cleavage of the following R substituted phenyltrimethylsilanes were determined; R being *m*- and *p*- Me, *i*-Pr, *t*-Bu, Ph and MeO. The rates of cleavage for both the meta and para alkylphenyltrimethylsilanes were found to increase in the same order as the inductive effects, that is,  $H < Me < i\text{-Pr} < t\text{-Bu}$ . One interpretation for the trend in the para series is that there is very little positive ion character developed in the ring in the transition state for this reaction. A linear relationship was found in the comparison of the relative reactivities as determined in the mercuric cleavages with the substituent constant  $\sigma$ .

##### Part III.

The isomer distributions for the metalation of cumene by *n*-amylsodium and *n*-amylpotassium were determined. Each reagent was prepared by two different methods. The sodium reagent metalated cumene almost exclusively on the nucleus, whereas the potassium reagent metalated the cumene side-chain almost exclusively. The initially formed nuclear substituted potassium products from the

metalation of cumene by *n*-amylpotassium rearranged under long reaction time to the more thermodynamically stable side-chain isomer.

Microfilm \$2.50; Xerox \$6.40. 134 pages.

#### DEHYDRATION OF ALCOHOLS *cis*- and *trans*-2-BENZYL-CYCLOPENTANOLS

(L. C. Card No. Mic 60-3599)

Laurence Scott McNamara, Ph.D.  
University of Pennsylvania, 1960

Supervisor: Dr. Charles C. Price

This work was undertaken in an attempt to elucidate the stereochemistry of the pyrolysis of methyl alkyl sulfite esters. The pyrolysis of *cis*- and *trans*-2-benzylcyclopentyl methyl sulfites has been extensively studied in this connection. The pyrolysis study of *cis*- and *trans*-2-phenylcyclohexyl methyl sulfites has been extended. In the course of this investigation the phosphoric acid catalyzed dehydration of *cis*- and *trans*-2-benzylcyclopentanols has been accomplished. The pyrolysis of *cis*- and *trans*-2-benzylcyclopentyl methyl xanthates has also been studied.

The acid catalyzed dehydrations gave essentially the same product mixture from each alcohol. This mixture consisted of 1-benzylcyclopentene (50-55%), 3-benzylcyclopentene (15-19%), benzylidenecyclopentane (15-20%), 1- and 3-phenylcyclohexene (3-5%), and 1,2 endoethylene-1,2,3,4-tetrahydronaphthalene (4-6%). It is suggested that this composition approaches equilibrium under the reaction conditions.

Pyrolysis of the methyl sulfite ester of *cis*-2-benzylcyclopentanol gave 75-80% of 1-benzylcyclopentene, 15% of 3-benzylcyclopentene, 2-3% of benzylidenecyclopentane, 1-2% of phenylcyclohexene and 2-4% of the naphthalene derivative. Similarly, the *trans*-methyl sulfite gave 50-55% 1-benzylcyclopentene and 35-40% of the 3-isomer, 4-5% of benzylidenecyclopentane and trace amounts of the skeletal rearrangement products.

A modification of the ester pyrolysis involving their decomposition in Dow Corning Silicone Fluid gave different results. The product mixture from the *cis* alcohol under these conditions consisted of about equal quantities of 1- and 3-benzylcyclopentene with 0-1% of each of the other isomers mentioned above. The *trans*-alcohol under the same conditions, gave 80% 1-benzylcyclopentene, 9% of 3-benzylcyclopentene, 8-11% benzylidenecyclopentane and traces of the remaining olefins.

The methyl sulfites of *cis*- and *trans*-2-phenylcyclohexanols were also pyrolyzed using this modification. The product mixture from the *cis*-isomer was 60% of 1-phenylcyclohexene, 35-40% of 3-phenylcyclohexene and 2% of benzylcyclopentenenes. The *trans*-alcohol gave 85-87% of 1-phenylcyclohexene, 6% of the 3-isomer and 7-8% benzylcyclopentenenes. The xanthate pyrolyses gave the products expected from a *cis*-concerted elimination.

Ultraviolet and infrared spectroscopy, refractive indices, and gas-liquid partition chromatography have been employed as analytical tools as well as chemical techniques involving oxidation and reduction of the product mixtures.



It has been proposed that several reaction mechanisms compete in the sulfite ester pyrolysis. The predominance of one mechanism over the others is a function of the conditions of the pyrolysis, the acidity of the  $\beta$ -hydrogen removed and of the over-all geometry of the molecule pyrolyzed. It is apparent that as pyrolysis conditions are made less favorable for ionic reactions, the concerted cis-elimination generally accepted for ester pyrolysis becomes increasingly important in the over-all reaction.

Incidental to this investigation 3-benzylcyclopentene, its epoxide and the epoxide of 1-benzylcyclopentene have been synthesized and their physical properties determined. The rates of epoxidation with perbenzoic acid of several olefins have been measured.

Microfilm \$2.50; Xerox \$6.20. 128 pages.

#### AROMATIC DIAMINO ALKYLATING AGENTS AND SOME 2-PHENYLBOROBENZIMIDAZOLINE DERIVATIVES

(L. C. Card No. Mic 60-3601)

John Joseph Miskel, Jr., Ph.D.  
University of Pennsylvania, 1960

Supervisor: Dr. Charles C. Price

In view of the cytotoxic activity of some aromatic nitrogen mustards, it was thought that some bis-aromatic nitrogen mustards might prove to be valuable, for use as anti-tumor agents.

Five nitrogen mustards related to  $\alpha,\omega$ -bis(p-aminophenoxy)alkanes, where the carbon chain varied from one to five, were synthesized. The synthesis was accomplished by condensing the appropriate  $\alpha,\omega$ -dihaloalkane with potassium p-nitrophenoxide, with subsequent reduction of the nitro compound to the amino compound by catalytic methods. The  $\alpha,\omega$ -bis(p-aminophenoxy)alkane was then reacted with ethylene oxide to produce the  $\alpha,\omega$ -bis(p-di- $\beta$ -hydroxyethylaminophenoxy)alkane, which was chlorinated with phosphorus oxychloride to yield the bis-aromatic nitrogen mustard derivative.

The synthesis of a bis-benzyl nitrogen mustard related to 1,6-bis(p-isopropylaminomethylphenoxy)hexane, a known antimalarial drug, was accomplished by reaction of the amino compound with ethylene oxide, followed by chlorination with thionyl chloride to give 1,6-bis(p-isopropyl- $\beta$ -chloroethylaminomethylphenoxy)hexane dihydrochloride.

Three alkylating agents of 1,5-diaminonaphthalene were prepared. These were the 1,5-bis(di- $\beta$ -chloroethyl) and 1,5-bis( $\beta$ -bromoethyl)naphthalene dihydrobromide. The reaction of 1,5-bis( $\beta$ -bromoethyl)naphthalene dihydrobromide with sodium hydroxide in dilute alcohol, yielded 1,5-bis(diethyleneimino)naphthalene.

The synthesis of some derivatives of the new class of compounds, called borobenzimidazolines related to the known antimetabolite, benzimidazole, was attempted to see if any cytotoxic activity was possible.

Four compounds in addition to 2-phenylborobenzimidazoline were prepared by reacting the appropriate o-phenylenediamine derivative with phenyldichloroborane in dry benzene, followed by refluxing. The compounds prepared were the 5-chloro, 5-nitro, 5-ethoxy, and 4-

chloro-6-nitro, 2-phenylborobenzimidazoline derivatives. The infra-red and ultraviolet spectra of these compounds are also reported.

Any attempt to adapt this method of preparation to the pyrimidine nucleus failed, possibly because of the insolubility of the 4,5-diaminopyrimidines and their partial imino character. Microfilm \$2.50; Xerox \$4.60. 89 pages.

#### THE CONFORMATION OF THE TRANSITION STATE IN THE o-CLAISEN REARRANGEMENT

(L. C. Card No. Mic 60-4121)

Bruce Edward Norcross, Ph.D.  
The Ohio State University, 1960

Ever since Claisen's original researches in the early 1900's on the rearrangement which bears his name, much interest has been shown in the nature of the transition state and in the intermediates leading to the products of this reaction. Although Claisen in 1925 postulated a mechanism that has been shown to be correct in all respects, no detailed description of the geometrical conformation of the transition state has been possible from the existing data.

In the present investigation, a study has been made of the rates of rearrangement of  $\beta$ -substituted allyl aryl ethers, and of cis-trans- $\gamma$ -substituted allyl aryl ethers.

The kinetic parameters for each compound studied are listed in the following order: enthalpy of activation ( $\Delta H^\ddagger$ , kcal. mole<sup>-1</sup>), entropy of activation ( $\Delta S^\ddagger$ , cal. deg.<sup>-1</sup>, mole<sup>-1</sup>), and rate constant ( $k_1$ , sec<sup>-1</sup> x 105) at the temperature used.

Allyl phenyl ether (determined by H. L. Goering and R. R. Jacobson, J. Am. Chem. Soc., 80, 3277 (1958)), 32.3, -11.1, 1.52 (184.85°), 3.86 (197.29°);  $\beta$ -methylallyl phenyl ether (Goering and Jacobson), 31.1, -14.0, 1.19 (183.96°), 1.32 (184.85°), 3.29 (197.29°);  $\beta$ -t-butylallyl phenyl ether, 35.0, -5.2, 1.52 (185.27°), 3.27 (195.11°), 4.00 (197.22°), 9.96 (208.40°); allyl p-methoxyphenyl ether (Goering and Jacobson), 33.0, -7.3, 4.58 (184.85°), 12.2 (197.29°);  $\beta$ -methylallyl p-methoxyphenyl ether, 36.2, -0.9, 3.23 (183.88°), 3.33 (184.48°), 8.15 (194.37°), 8.20 (194.37°), 18.00 (204.57°);  $\beta$ -t-butylallyl p-methoxyphenyl ether, 31.6, -9.7, 6.48 (184.87°), 13.3 (194.38°), 27.9 (204.52°); allyl 3,5-dimethylphenyl ether, 35.4, -2.8, 3.22 (184.94°), 6.87 (194.37°), 7.18 (194.38°), 8.31 (197.00°), 16.5 (204.36°);  $\beta$ -methylallyl 3,5-dimethylphenyl ether, 33.2, -7.4, 3.65 (185.02°), 7.85 (194.37°), 17.0 (204.72°);  $\beta$ -t-butylallyl 3,5-dimethylphenyl ether, 33.3, -6.2, 5.88 (184.87°), 11.7 (194.38°), 27.0 (204.46°); trans-crotyl p-methoxyphenyl ether, 19.8, -37.6, 2.24 (184.99°), 4.12 (197.14°), 4.98 (200.27°), 6.20 (208.50°), 6.62 (209.16°), 11.9 (219.40°); cis-crotyl p-methoxyphenyl ether, 19.0, -40.5, 2.40 (200.11°), 3.78 (208.55°), 5.61 (219.40°); trans-cinnamyl p-methoxyphenyl ether, 36.2, 0.5, 3.35 (176.96°), 6.88 (184.54°), 7.58 (186.73°), 20.1 (197.20°); cis-cinnamyl p-methoxyphenyl ether, 34.8, -4.0, 3.44 (183.54°), 7.96 (196.96°), 22.4 (208.55°); trans-crotyl 3,5-dimethylphenyl ether, 21.2, -34.5, 4.96 (200.20°), 7.46 (208.41°), 19.6 (229.74°); cis-crotyl 3,5-dimethylphenyl ether, 28.1, -21.4, 3.96 (208.66°), 7.64 (219.43°), 14.1 (229.73°); trans-cinnamyl

3,5-dimethylphenyl ether, undetermined, undetermined, 4.98 (184.90°), 7.63 (197.12°), 10.6 (206.91°), 17.5 (217.88°); *cis*-cinnamyl 3,5-dimethylphenyl ether, undetermined, undetermined, 4.56 (208.66°), 4.88 (208.46°), 7.53 (219.48°), 18.1 (229.77°).

These data support the view that the transition state has the allyl side chain in a plane nearly parallel to the plane of the aromatic moiety with the atoms arranged in an "elbowed-out" conformation, wherein the  $\alpha$ -carbon of the chain is directly superimposed over the ring oxygen and the  $\gamma$ -carbon is over the *o*-position to which it will become attached, while the  $\beta$ -carbon is not superimposed over any atom of the ring.

Microfilm \$2.50; Xerox \$3.80. 70 pages.

#### APPLICATIONS OF THE OCTANT RULE TO CONFORMATIONAL PROBLEMS IN THE CYCLOHEXANONE SERIES

(L. C. Card No. Mic 60-3824)

Jeanne Vuilleumier Osiecki, Ph.D.  
Stanford University, 1960

A series of polyalkylated cyclohexanones has been synthesized in order to determine which conformer prevails in each case.

The optical rotatory dispersion curves of these compounds have been measured. On the basis of their molecular amplitudes, the signs of the Cotton effects, and the application of the "octant rule," it is possible to ascertain qualitatively the predominance of a given conformer.

Microfilm \$2.50; Xerox \$5.40. 109 pages.

#### THE PHOSPHORYLATION OF CHLORAMPHENICOL

(L. C. Card No. Mic 60-3828)

Herbert Charles Prosser, Ph.D.  
Stanford University, 1960

Various attempts have been made to prepare a phosphate ester of chloramphenicol with the purpose in mind that the enhanced water solubility would facilitate parenteral administration of the drug, thereby increasing its value under conditions where oral administration was not feasible.

The work reported in this thesis is concerned primarily with the isolation, characterization and properties of a crystalline cyclic chloramphenicol phosphate *D*(-)-threo-1-*p*-nitrophenyl-2-dichloroacetamido-1,3-diol cyclic phosphate (H. S. Mosher, J. Reinhart and H. C. Prosser; *J. Am. Chem. Soc.*, 75, 4899 (1953)). Cyclic phosphates containing a six-membered phosphate ring system have until recent years been unknown.

Chloramphenicol cyclic phosphate was pharmacologically inactive, although it was hoped that the phosphoesterase enzymes widely found in animal tissue would form free chloramphenicol *in vivo*.

'Protected' phosphorylation of chloramphenicol resulted in the preparation of crystalline dimethyl and di-

phenyl chloramphenicol phosphates and a dibenzyl chloramphenicol phosphate. The phosphorylation of other compounds related to chloramphenicol was also studied.

The acid hydrolysis of both the cyclic and the substituted tertiary non-cyclic phosphate esters of chloramphenicol was investigated with extensive use of infrared analysis. An interpretation of the hydrolysis data for the cyclic phosphate led to postulation of a probable mechanism by which this substance hydrolyzes.

Protecting methyl, phenyl or benzyl groups could not be satisfactorily removed from the substituted chloramphenicol phosphates by commonly employed methods of hydrogenolysis or hydrolysis without reducing the aromatic nitro group or hydrolyzing the amide bond in chloramphenicol. A non-cyclic primary phosphate ester could therefore not be obtained by the phosphorylation methods available to the author during the experimental work of this thesis. Since then some newer methods of forming primary phosphate esters have become available. These methods are discussed as to their possible use for synthesizing a non-cyclic phosphate ester of chloramphenicol.

Microfilm \$2.50; Xerox \$5.40. 110 pages.

#### SYNTHESIS WITH ORGANOMETALLIC COMPOUNDS. A NEW ROUTE TO ISOBENZOFURANS.

(L. C. Card No. Mic 60-3985)

William Carl Rife, Ph.D.  
University of Illinois, 1960

*o*-Aroyldiarylcarbinols should be converted to 1,3-diarylisobenzofurans on treatment with acid; this proposal was verified by treatment of *o*-duroylphenylphenylcarbinol with acid and the subsequent isolation of 1-duryl-3-phenylisobenzofuran in 83% yield. The same isobenzofuran was also obtained by condensing benzaldehyde with *o*-duroylphenyllithium, and rendering the reaction mixture strongly acidic prior to the workup. The yield of 1-duryl-3-phenylisobenzofuran by this route was 43%. Four other 1-duryl-3-aryl isobenzofurans were also prepared by this latter method; these were 1-duryl-3-(2-methoxyphenyl)isobenzofuran, 1-duryl-3-(4-methoxyphenyl)isobenzofuran, 1-duryl-3-(2-chlorophenyl)isobenzofuran, and 1-duryl-3-(4-chlorophenyl)isobenzofuran. The yields were in the range 30-40%. The Diels-Alder adduct from 1-duryl-3-phenylisobenzofuran and maleic anhydride was prepared, but could not be purified because of its sensitivity to heat.

A second route to the isobenzofurans was also explored; in this connection it was desirable to prepare *o*-duroylbenzaldehyde. Several possible routes to this aldehyde were investigated. The known *o*-duroylbenzoyl chloride was prepared and treated with lithium tri-*t*-butoxyaluminumhydride in an attempt to effect a selective reduction to the desired aldehyde. Although a small quantity (0.8%) of the aldehyde was obtained, the method could not be made to proceed satisfactorily or consistently. A sample of *N,N*-dimethyl-*o*-duroylbenzamide was prepared and reduction of the amide to *o*-duroylbenzaldehyde was attempted by treatment of the amide with lithium diethoxyaluminumhydride. None of the desired product could be isolated. *o*-Duroyltoluene was prepared and attempts were made to oxidize the conjugated methyl group of this



ketone with selenium dioxide and with N-bromosuccinimide and dimethyl sulfoxide. Only the starting material was recovered. An available sample of *o*-duroylbenzyl alcohol was also subjected to treatment with selenium dioxide and with N-bromosuccinimide; again no oxidation could be effected. *o*-Hydroxymethylphenyldurylcarbinol was prepared and treated with N-bromosuccinimide, but conversion to *o*-duroylbenzaldehyde did not take place. Another suggested route to the aldehyde was by condensation of *o*-duroylphenyllithium with phenylglyoxal and cleavage of the resultant benzoin with periodate. The lithium reagent, however, could not be made to condense with phenylglyoxal. Attempted conversions of *o*-duroylstyrene and *o*-mesitoylstyrene to the corresponding lateral glycols by oxidative routes involving perbenzoic acid and osmium tetroxide, respectively, were also unsuccessful. The osmium reagent produced an intractable black oil, probably the osmate ester of the desired glycol, and perbenzoic acid could not be made to oxidize the lateral double bond of *o*-duroylstyrene under the conditions used. An investigation of the magnesium derivatives from  $\alpha,\omega$ -dihaloalkanes and halogenated benzyl halides was also carried out. Treatment of 1,6-di(bromomagnesium)hexane with ethyl formate resulted in the formation of a polymeric formate ester. Formation of a di-Grignard reagent from *o*- or *p*-bromobenzyl chloride could not be effected, although a variety of methods was tried. Some proposed uses for halomagnesium enolates and acetylides were also investigated. An attempt to condense the bromomagnesium enolate of acetomesitylene with acetomesitylene and with  $\alpha$ -chloroacetomesitylene was unsuccessful. An attempt to displace the methoxyl group of 1-mesitoyl-2-methoxynaphthalene by treatment with phenylethynylmagnesium bromide was also unsuccessful; only the starting materials were recovered. Microfilm \$2.50; Xerox \$7.00. 147 pages.

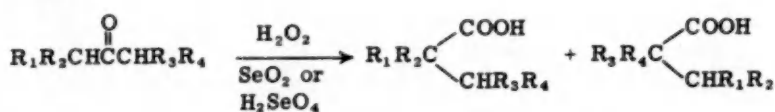
#### THE OXIDATIVE REARRANGEMENT OF KETONES TO CARBOXYLIC ACIDS

(L. C. Card No. Mic 60-5291)

Avery Rosegay, Ph.D.  
New York University, 1960

Adviser: Professor H. M. Hellman

Monofunctional open-chain and cyclic ketones which have the grouping  $>\text{CHCOCH}<$  react with hydrogen peroxide and a catalytic amount of selenium dioxide or selenic acid to give carboxylic acids by oxidative rearrangement (1,2,3).



Methyl ketones,  $\text{CH}_3\text{COR}$ , in which R = ethyl, isopropyl, and benzyl, rearrange to give mixtures of isomeric products in which the more highly substituted acid predominates (major products, 11-80%; minor, <1%). Cyclopropyl methyl ketone forms cyclopropaneacetic acid as the only rearrangement product. Acetone and 2,4-dimethyl-3-pentanone give rise to propionic acid and 2,2,3-tri-

methylbutyric acid, respectively. 2-Methyl-3-pentanone rearranges to both possible isomeric acids in about equal yield. The yields of hindered acids are low (ca. 15%).

The treatment of cyclic ketones with hydrogen peroxide and selenic acid results in the formation of carboxylic acids by oxidative ring contraction (1). Cyclopentanone, cyclohexanone, and 2-tetralone give cyclobutanecarboxylic acid (35%), cyclopentanecarboxylic acid (66%), and 1-indanecarboxylic acid (14%), respectively. Cyclobutanone and 2-indanone do not undergo oxidative rearrangement.

#### General procedure

A solution of ketone, solvent (tetrahydrofuran, dioxane, or *t*-butyl alcohol; 2-4 ml. per ml. of ketone), 30% hydrogen peroxide (1.5 - 2 moles per mole of ketone) and selenic acid (about 3 mole per cent of ketone) is heated at reflux for 2-5 hours. Selenic acid (which gives better yields than selenium dioxide) is either first dissolved in the hydrogen peroxide, or added to the reaction mixture after the peroxide is introduced. This avoids reduction of the catalyst by the ketone. Some ketones react exothermically. After the solution is heated to boiling, any initial exothermic reaction is allowed to subside before reapplying heat. In preparations involving the use of more than about 0.5 mole of ketone, the exothermic reaction may be controlled by the gradual addition of a solution of peroxide and catalyst to the previously refluxed ketone and solvent without heating. At the end of the reflux period, volatile acids are isolated by making the mixture alkaline, steam distilling to remove neutral material, acidifying, and steam distilling the products, which are then extracted and rectified. Non-volatile acids are isolated by distilling the alkaline mixture to remove solvent, extracting neutral substances, acidifying, and extracting the products.

- (1) G. B. Payne and C. W. Smith, *J. Org. Chem.*, **22**, 1680 (1957).
- (2) N. Sonoda and S. Tsutsumi, *Bull. Chem. Soc. Japan*, **32**, 505 (1959).
- (3) H. M. Hellman and A. Rosegay, *Tetrahedron Letters*, No. 13,1 (1959).

Microfilm \$2.50; Xerox \$3.80. 67 pages.

#### THE STEREOCHEMISTRY OF THE CATALYTIC HYDROGENATION OF CYCLOALKENES

(L. C. Card No. Mic 60-4793)

James-Frederick Sauvage, Ph.D.  
Northwestern University, 1960

Advisers: Dr. Robert H. Baker and  
Dr. Allen S. Hussey

The roles of catalyst and olefin geometry in determining the stereochemistry of the catalytic hydrogenation of cycloalkenes were investigated.

The olefins chosen for the study were 1,7-, 1-, 3-, and 4,8-*p*-menthene (I-IV, respectively),  $\Delta^9,^{10}$ -octalin (V), 4-methylmethylenecyclohexane (VI), 1,4-dimethylcyclohexene

(VII), and 1-methyl-4-*t*-butylcyclohexene (VIII). The catalysts used were commercial platinum oxide, 10% palladium on charcoal, and 5% rhodium on charcoal. The reductions were run in a microhydrogenation apparatus at one atmosphere and room temperature. Either purified glacial acetic acid or purified ethanol was used as the solvent.

The starting materials, the products, and the mixtures resulting when the reductions were interrupted at 25-50% of theoretical completion were analyzed very accurately by gas-liquid partition chromatography (GLPC).

It was determined that no isomerization of the saturated products occurred in either the hydrogenation or the isolation procedures. Similarly, no isomerization of the olefins occurred in the isolation procedure.

The predominant products, both in this study and in that of Siegel,<sup>1</sup> which resulted from the reduction in acetic acid over platinum oxide of 1,3-, 1,4-, 2,3-, and 2,4-disubstituted cyclohexenes may be predicted by making the following assumptions:

1. The rate-determining step occurs during the adsorption of the substrate on the catalyst.
2. The transition state of this step closely resembles the pseudo boat form of the cyclohexene.
3. Bonding of the substrate to the catalyst develops *exo* to the pseudo boat form.
4. *Cis* addition of the two hydrogen atoms follows from the direction of the catalyst surface.
5. The steric requirements of that substituent at a distance from the double-bond determines whether the adsorption leading to the *cis*-isomer or the *trans*-isomer predominates.

6. When the 4-substituent is small (methyl or ethyl) an *endo* configuration is preferred to an *exo*, where interference with the catalyst exists. The reverse is true of larger groups where the *endo* position is unfavorable. A "bowsprit" 3-substituent is favored in all cases.

There was little or no observed isomerization of the substrates during the course of hydrogenation over platinum oxide.

The reductions of the 1,2-disubstituted cyclohexenes (V in this study and 1,2-dimethylcyclohexene<sup>1</sup>) gave anomalous quantities of *trans*-product, which are presently unexplainable.

Reductions in the platinum-acetic acid system of the semicyclic olefins examined in this study and by Siegel<sup>1</sup> followed the course proposed originally by Siegel<sup>2</sup> for substituted cyclohexanones with one exception. Both the product mixture from IV and the relatively large amount of isomerization of the double-bond during its reduction indicated that the rate-controlling step for this tetrasubstituted semicyclic olefin was shifted to a transition state between the diadsorbed species and the product.

Ethanol was unsuited as a solvent for reduction over platinum oxide.

Reductions over palladium on charcoal in either ethanol or acetic acid resulted in predominant production of the more stable saturate. Extensive isomerization during the course of hydrogenation was observed. The inference was that the rate-determining step for reduction over this catalyst was very close to the product.

Only I-V were reduced over rhodium on charcoal, and the results are inconclusive. Observed isomerization during reduction was extensive, although not as great as over palladium. The predominant product in all cases was

the unstable isomer. The results may be as much a function of the supporting charcoal as of the metal.

The methods of preparation of I-VII were given.

The reduction of naphthalene and tetralin by lithium in ethylamine<sup>3</sup> was investigated with the aid of GLPC. The relative proportion of the resulting  $\Delta^{1,9}$ - and  $\Delta^{9,10}$ -octalins was much nearer unity than reported.<sup>3</sup> The heating of these octalins over phosphorus pentoxide resulted in a preferential polymerization of the  $\Delta^{1,9}$ -octalin rather than the reported<sup>3</sup> isomerization of the  $\Delta^{1,9}$ -isomer to V. An equilibrium mixture of the octalins was produced, however, by heating over a "benzyl sodium" catalyst.<sup>4</sup>

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Microfilm \$2.50; Xerox \$4.00. 74 pages.

#### EXTRACTION, SEPARATION AND CHARACTERIZATION OF THE HIGH MOLECULAR WEIGHT ORGANIC MATERIALS IN SOIL.

(L. C. Card No. Mic 60-4130)

Richard Bernhard Schwendinger, Ph.D.  
The Ohio State University, 1960

A Brookston silty clay loam was used as a model system to develop methods for the extraction, separation, and characterization of high molecular weight soil organic matter.

A 60-hour Soxhlet extraction with distilled water removed approximately 8 per cent of the total soil organic matter. Pressure filtration through a bacterial filter removed most of the colloidal clay. A second pressure filtration through a cellophane membrane with a 48 Å pore diameter separated the low molecular weight material from the high molecular weight species. The low molecular weight material constituted the bulk of the total water extract of the soil.

The high molecular weight organic matter was mainly composed of polysaccharides and was a light straw color. When applied to a continuous flow paper electrophoresis apparatus in phosphate buffer of pH 5.2, it separated into four main components on the basis of charge. This charge was due to uronic acids.

A single extraction in the cold with neutral 0.1 M pyrophosphate removed approximately 25 per cent of the total soil organic matter. Low molecular weight organic materials as well as inorganic salts were removed by dialysis or pressure filtration. Clay was found to be a contaminant when the acid precipitable portion was subjected to x-ray powder diffraction analysis. Centrifugation at 25,000 times gravity failed to remove the strongly adsorbed clay.



Various treatments of this pyrophosphate extract with both HCl and HF were tried. A solution 0.3 M in HCl and 0.3 M in HF decomposed the clay when shaken for ten minutes in the cold. Extended treatment with the various HCl-HF mixtures produced unidentified x-ray patterns and showed that the extraction time was critical.

Infrared spectra of the acid precipitable organic matter from the pyrophosphate extract were run by using KBr pellets. From a comparison with the spectra of known polymers and from a study of the spectra themselves, these humic acids were shown to be polyelectrolytes whose charge is due mainly, if not completely, to carboxylic acids. No positive evidence for the presence of phenols was found. The carboxylic acids were found to change reversibly from the acid to the salt form.

The organic matter from the pyrophosphate extracts was run on the continuous paper electrophoresis apparatus in both phosphate buffer at pH 5.2 and borate buffer at pH 9.1. There was one main highly charged brown-colored component. Some slightly charged polysaccharides were separated from the main component, and these probably corresponded to the water-extractable polysaccharides studied above.

Infrared spectroscopy was used to monitor one of the electrophoresis runs. While it was a time-consuming operation to collect and prepare sufficient samples, it was found to detect differences not shown in the chemical tests used. Microfilm \$2.50; Xerox \$5.00. 98 pages.

#### STUDIES OF THE PREPARATION AND REACTIONS OF SOME ORGANOPHOSPHORUS COMPOUNDS

(L. C. Card No. Mic 60-4261)

Lois Crisbacher Smith, Ph.D.  
Rutgers University, 1960

Major Professor: Donald B. Denney

##### I The Formation of Olefins from Weakly Basic Phosphoranes and Peracetic Acid

It has been found that weakly basic phosphoranes react with peracetic acid to give poor to good yields of the dimeric olefin and excellent yields of triphenylphosphine oxide. Phosphoranes having structures  $(C_6H_5)_3P=CR-CO-R'$  where  $R = H, CH_3$  and  $R' = CH_3, C_6H_5, OC_2H_5$  have been investigated; *trans* olefins having structures  $R'-CO-CR=CR-CO-R'$  have been isolated.

Variation of olefin yield with phosphorane basicity has been discussed, as has the fact that reaction of phenylmethylenetriphenylphosphorane with peracetic acid does not yield stilbene but rather toluene and the oxide. These results are discussed and have been incorporated into a proposed mechanism.

##### II A Study of the Preparation and Reactions of Some New Phosphonium Salts

Three new carboxyphosphonium salts having structures  $[(C_6H_5)_3P^+-(CH_2)_n-COOH] Cl^-$  where  $n = 1, 2$  and  $3$  have been prepared. Reaction of these materials with aqueous bases has been studied. When  $n = 1$ , treatment with bi-

carbonate followed by pyrolysis of the resulting mixture yielded triphenylmethylphosphonium chloride, diphenylmethylphosphine oxide and carbon dioxide. No triphenylmethylenephosphobetaine, described by Michaelis and Gimborn, was obtained from this carboxyphosphonium salt or from the reaction of carbethoxymethyltriphenylphosphonium chloride or bromide with dilute or concentrated base. In the latter case, only carbethoxymethylenetriphenylphosphorane was obtained.

When  $n = 2$  or  $3$ , reaction with dilute base afforded the desired phosphobetaines,  $(C_6H_5)_3P^+-(CH_2)_n-COO^-$ . Treatment of these phosphobetaines with aqueous hydrochloric acid regenerated the carboxyphosphonium chloride salts. Pyrolysis afforded triphenylphosphine and acrylic acid when  $n = 2$  and triphenylphosphine and  $\gamma$ -butyrolactone when  $n = 3$ . Infrared data and physical properties indicated that these phosphobetaines existed as zwitterions and were not cyclic structures containing pentavalent phosphorus.

The reaction of bromoacetic acid with triphenylphosphine to yield triphenylphosphine oxide and either acetyl bromide or ketene and hydrogen bromide has been described and possible mechanisms have been discussed.

The preparation of triphenylacetylphosphonium bromide and preliminary work on its reaction with aqueous base have been reported.

Preliminary work on the preparation of phosphobetaines from phosphonium salts of halo alcohols, specifically by treatment of  $\gamma$ -hydroxypropyltriphenylphosphonium bromide with sodium ethoxide, has been carried out. The possibility that phosphobetaines of this type might provide a route to useful cyclopropane derivatives has been noted. Microfilm \$2.50; Xerox \$4.60. 90 pages.

#### THE ADDITION OF ARYL GRIGNARD REAGENTS TO 3-BENZOYLFURANS

(L. C. Card No. Mic 60-3997)

Wilburn Suber Smith, Jr., Ph.D.  
University of Illinois, 1960

The reaction of 2-phenyl-4-benzoylfuran with Grignard reagents had been studied; this ketone had previously been shown to undergo a diaddition reaction with phenylmagnesium bromide. An analogous reaction has been found to occur with *p*-tolylmagnesium bromide. In contrast to other examples of diaddition, this reaction has been shown to occur under normal conditions with only a slight excess of the Grignard reagent. To account for the difference in reactivity between 2-phenyl-4-benzoylfuran and an open-chain analogue such as  $\alpha$ -styrylchalcone, a mechanism has been proposed in which opening of the furan ring assists in the addition of a second mole of the Grignard reagent. The product of the reaction has been found not to be dependent on the method of hydrolysis or on the presence of excess reagent during the hydrolysis step.

Treatment of the reaction mixture with carbon dioxide gave, instead of the expected hydroxy acid, only the usual diaddition product. Addition of benzoyl chloride to the reaction mixture prior to hydrolysis gave a rearranged product, 2,5-diphenyl-3-diphenylmethylfuran, which had previously been formed by isomerization of the normal diaddition product.

Efforts to obtain a mono-addition product by limiting the amount of Grignard reagent gave only unchanged starting material when less than 2.5 moles of reagent per mole of ketone were used. When this ratio was 2.5:1 or larger, the diaddition product was formed.

When 2,5-diphenyl-3-benzoylfuran was treated with phenylmagnesium bromide, no diaddition occurred. Instead, 1,2-addition to the carbonyl group gave the alcohol, 3-(2,5-diphenylfuryl)-diphenylcarbinol. The structure of this compound was established by converting it to 3-(2,5-diphenylfuryl)-diphenylmethane, a known compound.

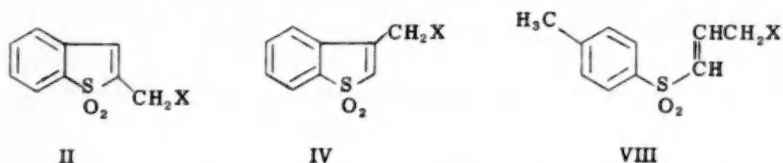
Microfilm \$2.50; Xerox \$5.00. 97 pages.

### SUBSTITUTION AND REARRANGEMENT REACTIONS IN THE BENZOTHIOPHENE 1,1-DIOXIDE SERIES.

(L. C. Card No. Mic 60-4797)

Philip Edward Sokol, Ph.D.  
Northwestern University, 1960

The rates of reaction of thiourea with the *n*-propyl halides, the allyl halides, the 2-halomethylbenzothiophene 1,1-dioxides (II), the 3-halomethylbenzothiophene 1,1-dioxides (IV), and the 3-halo-1-*p*-toluenesulfonyl-1-propenes (VIII) in methanol were determined conductometrically at two temperatures, 25.0° and 50.0°.

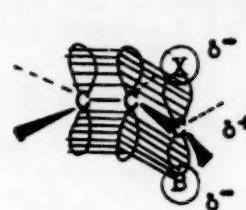


Whereas the simple allyl halides, II, and VIII react by  $S_N2$  mechanisms with nucleophilic reagents, IV reacts by an  $S_N2'$  mechanism. The kinetic results are summarized below.

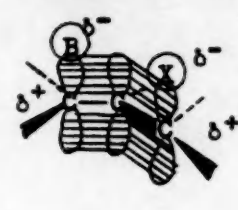
Kinetic Data for the Reaction of Thiourea with Propyl and Allyl Halides in Methanol at 25.0°

Halide	Rel. Rates			Activation Energies			Activation Entropies		
				(kcal./mole)			(Entropy units)		
	Cl	Br	I	Cl	Br	I	Cl	Br	I
<i>n</i> -C <sub>3</sub> H <sub>7</sub> X	1.0	128	556	21.6	17.8	14.6	-19.5	-22.5	-30.5
H <sub>2</sub> C=CHCH <sub>2</sub> X	1.0	62	183	15.8	13.7	13.3	-27.9	-26.5	-25.9
II	1.0	28	75	14.3	12.8	13.6	-29.9	-28.2	-23.5
IV	1.0	79	230	14.3	12.7	12.5	-29.9	-26.6	-24.8
VIII	1.0	82	312	13.7	13.1	12.8	-32.9	-25.8	-24.5

The rates of reaction of IV with thiourea represent the first report of the element effect in an  $S_N2'$  reaction. The similarities in relative rates of reaction and activation entropies for the four allylic halide systems suggest that they are employing transition states of similar nature. Since the structure of the  $S_N2'$  transition state is known, the  $S_N2$  transition state structure must be of a comparable nature. In both reactions a very favorable orbital overlap situation exists.



$S_N2$  Transition State



$S_N2'$  Transition State

The chloride (IVa) and bromide (IVb) of IV were shown to undergo a base catalyzed tautomerization reaction to give 3-halomethylene-2,3-dihydrobenzothiophene 1,1-dioxide (IX), and it could be demonstrated by spectral and conductometric kinetic measurements that IVb is converted very rapidly to IXb, and that IXb provides a ready supply of IVb, by a tautomerization reaction, to react with piperidine by an  $S_N2'$  mechanism to give 2-(1-piperidino)-3-methylbenzothiophene 1,1-dioxide.

3-Chloromethylbenzothiophene 1,1-dioxide (IVa) was shown to undergo  $S_N2'$  reactions with methanethiolate, mesitylenethiolate, thiocyanate, and azide ions, and  $S_N2$  reactions with bromide and iodide ions.

The chloro (Xa) and bromo (Xb) derivatives of the 3- $\alpha$ -haloethylbenzothiophene 1,1-dioxide system (X) were prepared and it could be demonstrated that Xa undergoes an  $S_N2'$  reaction with piperidine and an  $S_N2$  reaction with bromide ion, however, Xa was unreactive with thiourea and did not tautomerize in basic media.

The base-catalyzed rearrangement of the 3-aryloxy-methylbenzothiophene 1,1-dioxide system was studied employing the benzoate, mesitoate, *p*-anisate, and *p*-nitrobenzoate esters. It was demonstrated that the reaction is: kinetically second order, first order in base and first order in ester; not acid-catalyzed or thermally promoted; intramolecular; dependent on base strength; subject to small substituent effects on the aryloxy group. This information suggests that the first and rate determining step is a proton abstraction from the 3-methylene carbon atom. A new and convenient synthesis of mesitoic acid from mesitylene and oxalyl chloride is reported in connection with the ester rearrangements.

Microfilm \$2.50; Xerox \$6.00. 125 pages.

### STRUCTURAL STUDIES ON OAT GLUCAN

(L. C. Card No. Mic 60-3560)

Heinz Sorger-Domenigg, Ph.D.  
University of Minnesota, 1959

Oat gum, the substance responsible for the high viscosity of aqueous dispersions of oat meal, was isolated from oat flour which had been boiled with methanol and with acetone to inactivate the enzymes. The oat gum was extracted with water and purified by acetylation. The oat gum, regenerated from its acetate, was fibrous in nature; it was homogeneous (ultracentrifuge), showed  $[\alpha]_D + 6^\circ$  (N NaOH), and gave only *D*-glucose upon hydrolysis.

The methylated oat gum,  $[\alpha]_D - 13^\circ$  (acetone), obtained by treatment with methyl iodide and sodium in liquid ammonia afforded upon hydrolysis a mixture of 2,3,6- and 2,4,6-tri-O-methyl-*D*-glucose, 2,3-di-O-methyl-*D*-glucose and 2,3,4,6-tetra-O-methyl-*D*-glucose which were



separated by column chromatography on cellulose-hydrocellulose.

The ratio of 1 → 4 to 1 → 3 linkages was found to be 1.54:1.00 from the methylation study and 1.77:1.00 from periodate oxidation studies.

The average degree of polymerization (calculated from the amount of formaldehyde liberated upon treating the reduced ( $\text{NaBH}_4$ ) gum with  $\text{NaIO}_4$ ) was 1000, a value in good agreement with the minimum value (920) from ultracentrifugation experiments.

Periodate oxidation of the gum followed by reduction ( $\text{NaBH}_4$ ) and mild acid hydrolysis of the resulting polyalcohol afforded a mixture of erythritol, 2-O- $\beta$ -D-glucopyranosyl-D-erythritol, 2-O- $\beta$ -D-laminaribiosyl-D-erythritol, 2-O- $\beta$ -D-laminaritriosyl-D-erythritol and 2-O- $\beta$ -D-laminartetraosyl-D-erythritol. Enzymic hydrolysis ( $\beta$ -D-glucosidase) of the mixture of erythrityl glycosides gave erythritol and D-glucose, thus revealing that the 1 → 3 linked glucose residues had a  $\beta$ -configuration.

The experimental data indicated that portions of the oat gum contain 2 to 4 contiguous 1 → 3  $\beta$ -linked D-glucopyranosyl residues flanked by 1 → 4  $\beta$ -linked glucosyl residues; contiguous 1 → 4  $\beta$ -linked glucopyranosyl residues are also present. The greatest proportion of the structure of the gum consists of linear chains joined by alternating 1 → 3 and 1 → 4 bonds.

Enzyme-degraded oat gum was formed by allowing aqueous dispersions of the untreated oat flour to stand at 25° C. followed by precipitation with alcohol. Two preparations, I and II, showed  $[\alpha]_D - 9^\circ$  and  $-4^\circ$ , respectively, and upon hydrolysis gave only D-glucose. Specimen I, which had an average D.P. of 120 (determined by the formaldehyde method), gave a methyl derivative,  $[\alpha]_D - 12^\circ$  (acetone), OMe, 44.5, which, upon hydrolysis, afforded a mixture of 2,3,6-tri-O-methyl-D-glucose, 2,4,6-tri-O-methyl-D-glucose, 2,3,4,6-tetra-O-methyl-D-glucose and 2,3-di-O-methyl-D-glucose. The ratio of 1 → 4 to 1 → 3 linkages in I was found to be 2.24:1.00.

Specimen II of degraded oat gum had an average D.P. of 21 based upon the formic acid liberated during oxidation with periodate. Reduction ( $\text{NaBH}_4$ ) of the polyaldehyde and hydrolysis of the resulting polyalcohol with 0.2 N HCl at 25° gave glycerol in addition to the same mixture of compounds as was formed from the polyalcohol of the undegraded gum. The proportion of the erythrityl glycosides of the 1 → 3 linked glucose oligosaccharides was smaller than in the hydrolysate of the undegraded gum.

The ratio of 1 → 4 to 1 → 3 linkages in specimen II was 2.54:1.00, calculated from the molar ratio of erythritol to glucose in the complete hydrolysate of the corresponding polyalcohol. The molar ratio of glycerol to the sum of glucose plus erythritol indicated that the average repeating unit consisted of 19 glucose residues.

The viscosity of aqueous solutions of undegraded gum rapidly decreased when treated with an enzyme system extracted from ground oats with water. Comparison of the structural features of the degraded and the undegraded gum indicates that the contiguous 1 → 3  $\beta$ -linkages are preferentially cleaved by the oat enzyme system.

It is believed that the undegraded oat gum molecule contains approximately 1000 D-glucopyranose residues linked by  $\beta$ -glycosidic bonds. The structure, linear in the main, consists of groups of contiguous 1 → 4 and 1 → 3 linked glucose residues separated from each other by

linear portions of alternating 1 → 4 and 1 → 3 linked residues. Microfilm \$2.50; Xerox \$6.20. 126 pages.

## CYCLIC CONJUGATED SULFUR YLIDS

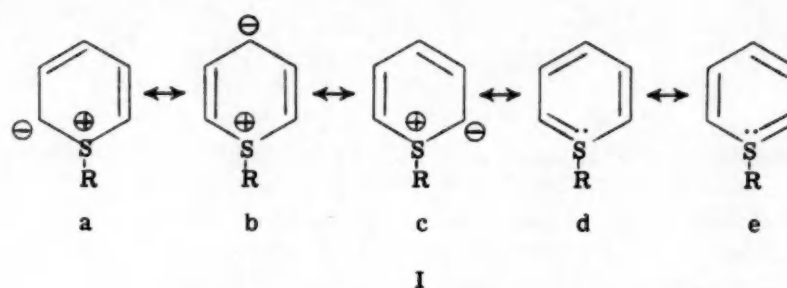
(L. C. Card No. Mic 60-3615)

George Suld, Ph.D.

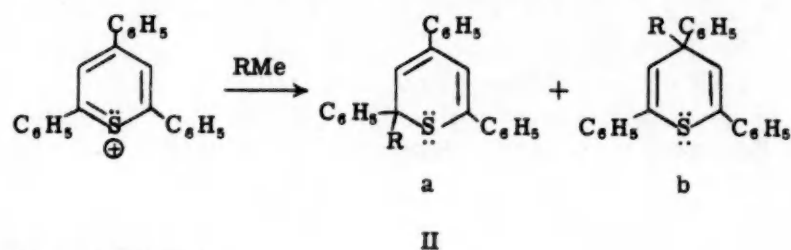
University of Pennsylvania, 1960

Supervisor: Charles C. Price

The broad objective of the present investigation was to study the possible valence shell expansion of di-covalent sulfur in a cyclic, quasi-benzenoid system I, in which a possible p-d  $\pi$  bond formation between carbon and sulfur (Id,e) would stabilize the charge-separated structures Ia,b,c.

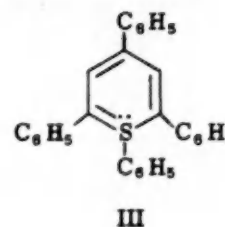


The reaction of triphenylthiopyrylium salts with organometallic reagents afforded in most instances mixtures of 2- and 4-substituted triphenylthiopyrans (IIa,b).

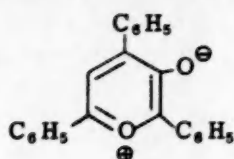


Me = -MgX, -Li

A colored, unstable sulfur ylid III, herein designated as 1,2,4,6-tetraphenylthiabenzene, was obtained from the triphenylthiopyrylium salts and phenyllithium.



The oxidative degradation of the tetraphenylthiabenzene proceeded via a complex set of rearrangements to give two isomeric compounds with an empirical formula  $\text{C}_{23}\text{H}_{18}\text{O}_3$ . As an intermediate in the oxidative degradation a red crystalline compound with an empirical formula  $\text{C}_{23}\text{H}_{18}\text{O}_2$  was formed. The structure of the red compound  $\text{C}_{23}\text{H}_{18}\text{O}_2$  (IV) was established by synthesis.



IV

The structures of the colorless  $C_{23}H_{18}O_3$  isomers remain to be elucidated.

Microfilm \$2.50; Xerox \$7.80. 169 pages.

#### A NEW HEXAMER OF ACRYLONITRILE

(L. C. Card No. Mic 60-3617)

Naomitsu Takashina, Ph.D.  
University of Pennsylvania, 1960

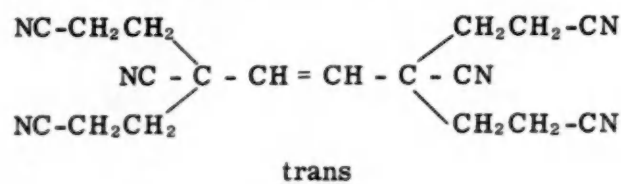
Supervisor: Dr. Charles C. Price

The catalytic activity of alkyl- and aryl-derivatives of the Group V elements, with the exception of nitrogen, on the polymerization reaction of acrylonitrile has been studied. The catalysts used were triethylphosphine, triphenylphosphine, triethylarsine, triphenylarsine, triphenylstibine and triphenylbismuthine.

Acrylonitrile was found to form a crystalline compound, having the melting point of  $240^\circ$  without decomposition, by the catalysis by triphenylphosphine in the presence of primary and secondary alcohols and also in the presence of water both at room temperature and at  $80^\circ$ . Among the primary alcohols, methanol was found to be less effective in the formation of the crystalline compound. At  $80^\circ$  *t*-butyl alcohol was also found to be effective.

The details of the above-mentioned reaction were investigated in the presence of ethanol, and beside the crystalline compound, 2-ethoxypropionitrile and a phosphorus-containing low molecular weight polymer were found to be formed.

The crystalline compound was found to be a hexamer of acrylonitrile,  $(C_3H_3N)_6$ . Its structure was investigated by means of chemical degradation, infrared spectrum, X-ray analysis and synthesis of authentic sample of the original compound and was found to be 1,1,4,4-tetracyanoethyl-1,4-dicyano-*trans*-2-butene.



The preparation of authentic sample of  $(C_3H_3N)_6$  was done by cyanoethylation of 1,4-dicyano-*trans*-2-butene by base catalysis.

All the other catalysts were found to form amorphous polyacrylonitrile. Among these, triphenylbismuthine was most effective in the formation of polyacrylonitrile under diffused light. Microfilm \$2.50; Xerox \$4.60. 89 pages.

#### THE FREE RADICAL REACTIVITY OF SOME NON-BENZENOID AROMATIC HYDROCARBONS

(L. C. Card No. Mic 60-2794)

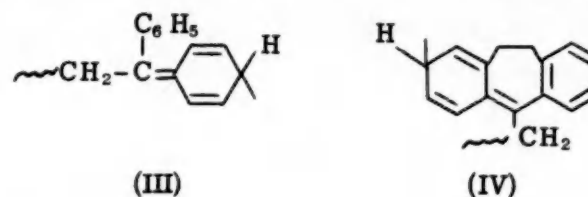
Fatemeh Taymoorian, Ph.D.  
University of South Carolina, 1960

##### Part I

Kinetic studies of the reactivity of a series of 6,6-dialkylfulvenes and 6,6-dialkylbenzofulvenes toward methyl methacrylate free radicals have provided evidence that these classes of compounds like their phenyl substituted counterparts undergo radical attack at one of the ring positions and not at the external 6-position. The experimental evidence seems to favor the 2-position as the site of radical attack.

##### Part II

The reactivity toward methyl methacrylate radicals of diphenylethylene (DPE), methylenedibenzocycloheptadiene (I) and dibenzoheptafulvene (II) has been studied both by measuring the retardation of methacrylate polymerization caused by these olefins and the composition of the "copolymers" formed when methyl methacrylate is polymerized in their presence. The most interesting fact is that the ultraviolet spectra of methacrylate-DPE and methacrylate-I copolymers show an intense maximum in the 290-310  $m\mu$  region which disappears on short treatment of the copolymer with dilute base. This behavior is strongly suggestive of the presence in the copolymers of 1,4-cyclohexadiene type units of structures III and IV,



resulting from anomalous reaction of the olefin free radicals at the *p*-position of one of the aromatic rings. The quantitative variation of the intensity of this maximum with total olefin content suggests that III and IV arise at least predominantly from termination reactions of radicals from DPE or I. Comparison of the reactivity data for I and DPE with that previously reported for dibenzofulvene seems at first to rule out Szwarc's hypothesis attributing the greater reactivity of the latter olefin to the stability of the fluorenyl radical. However, an explanation of the results is presented which still allows retention of the hypothesis.

##### Part III

The reaction of cyclooctatetraene with free radicals have been studied. It seems that further work is required in order to establish whether the retardation observed is due only to cyclooctatetraene or alternatively to a small amount of a reactive impurity.

Microfilm \$2.50; Xerox \$5.60. 113 pages.



# REACTION OF ORGANOMETALLICS WITH DIAZONIUM SALTS

(L. C. Card No. Mic 60-4006)

John Lowell Tveten, Ph.D.  
University of Illinois, 1960

The reaction of diphenylzinc with benzenediazonium fluoborate has been shown to give a nearly quantitative yield of *trans*-azobenzene. Results were comparable when the diphenylzinc was prepared from either the reaction of metallic zinc with diphenylmercury or of zinc bromide with phenyllithium. It was also observed that the reaction proceeded equally well in ether or dimethylformamide, but no azobenzene was produced in acetonitrile.

Spectral evidence showed that the presence of diphenylmercury favored the formation of *cis*-azobenzene, although it was found to be inert toward the diazonium salt itself.

Substituted *trans*-azobenzenes have likewise been prepared from the action of diphenylzinc on the corresponding diazonium salt. The *p*-nitro- and *p*-chloroazobenzenes were obtained in yields greater than 95% and the *p*-methoxyazobenzene in 72% yield.

It has been found that the mixed azo compound, benzene-azo-*t*-butane, was formed in 97% yield from di-*t*-butylzinc and benzenediazonium fluoborate; however, benzeneazomethane was not obtained from dimethylzinc in the same reaction.

Small amounts of *trans*-*p*-chloroazobenzene were produced from the reaction of *p*-chlorophenylzinc chloride with benzenediazonium fluoborate in ether, pyridine, and dimethylformamide, but no azobenzene was produced by the use of phenylmagnesium bromide, diphenylmagnesium, phenyllithium, or diphenylmercury.

Microfilm \$2.50; Xerox \$5.00. 99 pages.

# THE THERMAL DECOMPOSITION OF bis-*n*-HEPTANOYL PEROXIDE IN MIXED SOLVENTS

(L. C. Card No. Mic 60-4732)

Darthon Vernon Wells, Ph.D.  
University of South Carolina, 1960

The thermal decomposition of bis-*n*-heptanoyl peroxide was studied in thirty different solvent mixtures to determine (a) if intramolecular chain transfer occurs with the 1-hexyl radical, (b) to measure the relative reactivity of the 1-hexyl radical toward hydrogen abstraction and toward halogen abstraction, and (c) to compare the products with the analogous ones found with  $\delta$ -phenylvaleryl peroxide<sup>22</sup> in order to obtain further evidence about the mechanisms of the various steps.

A relatively complete product study was made in mixtures of carbon tetrachloride with benzene, with acetone, with toluene, and with cyclohexane. The products were analogous to those found in the comparable reactions of  $\delta$ -phenylvaleryl peroxide. In particular, 1,1,1-trichloroheptane was not found in the reaction mixtures; this substantiates the absence of 1,1,1-trichloro-5-phenylpentane reported earlier, and reinforces the hypothesis that ester, dimer, and certain other disproportionation products are the result of cage reactions.

The relative reactivities of the solvents toward 1-hexyl radicals were determined by measuring the relative quantities of 1-chlorohexane and of hexane produced in the various solvent mixtures. The 1-hexyl radical has a much higher selectivity than is shown by methyl radicals and is intermediate between methyl radicals and styryl radicals in this respect.

Appreciable quantities of 2-chlorohexane were not found. The absence of intramolecular chain transfer with the 1-hexyl radical is attributed to the hundred-fold faster reaction with carbon tetrachloride than with the methylene positions of the carbon chain (neglecting statistical factors). This supports the conclusion that intramolecular chain transfer does not occur with the 4-phenylbutyl radical.<sup>22</sup> Microfilm \$2.50; Xerox \$8.00. 171 pages.

# CHEMISTRY, PHARMACEUTICAL

## IRREVERSIBLE ENZYME INHIBITORS AS POTENTIAL ANTICANCER AGENTS

(L. C. Card No. Mic 60-4318)

Dilbagh S. Bariana, Ph.D.  
University of Kansas, 1960

1. Statement of the Problem. Anticancer agents of the antimetabolite type (e.g., aminopterin and 6-mercaptopurine) and of the nitrogen mustard type (e.g., mechlorethamine) act generally only to prolong life for a brief period of time because of development of resistance to these agents. An approach to this problem would be the designing of molecules which contain both a purine moiety and a nitrogen mustard grouping with the prospect of obtaining agents which would act as "irreversible enzyme inhibitors." It was planned to synthesize such compounds as well as other agents which do not conform so closely in type, for example, purine would be replaced with quinoline or benzene, and the nitrogen mustard grouping by diisothiocyanate.

2. Procedure. The intermediate 2[bis-(2-hydroxyethyl)-aminomethyl]-4-nitrophenol (I) and its methyl and ethyl analogs (II and III) were synthesized by the action of 2,2'-iminodiethanol on the chloromethyl products of *p*-nitrophenol and its methyl and ethyl ethers (IV, V and VI) respectively. Catalytic reduction of II and III gave the respective aniline derivatives (VII and VIII). The amines VII and VIII were condensed with 6-chloropurine, 4,7-dichloroquinoline and 2,4-dinitrochlorobenzene under proper conditions to yield N<sup>6</sup>- $\alpha$ -[Bis-(2-hydroxyethyl)-amino]-4-methoxy-*m*-tolyl-adenine (IX) and its 4-ethoxy analog (X), 4-2-[bis-(2-hydroxyethyl)-amino]-4-methoxy-*m*-toluidino-7-chloroquinoline (XI) and its 4-ethoxy analog (XII) and 4-(2,4-dinitroanilino)-2[bis-(2-hydroxyethyl)-aminomethyl]-anisole (XIII). The treatment of compounds IX, X, XI, XII and XIII with thionyl chloride gave the desired nitrogen mustards XIV, XV, XVI, XVII and XVIII, respectively. 2-(2-Hydroxyethylaminomethyl)-4-nitroanisole (XIX) and its phenetole analog (XX) were prepared by the action of 2-hydroxyethylamine on V and VI. Catalytic reduction of XIX and XX gave the corresponding aniline derivatives (XXI and XXII). The amine XXI was

condensed with 4,7-dichloroquinoline and the resulting product on treatment with thionyl chloride gave the desired monofunctional quinoline mustard (XXIII).

The compounds I, II, III, VII, VIII, XIX and XX on treatment with thionyl chloride gave the respective nitrogen mustards (XXIV-XXX) where benzene is a carrier group. The required diisothiocyanates were synthesized by the action of thiophosgene on the corresponding diamines. The diamines in turn were prepared by the action of dinitrochlorobenzene and dinitrobenzoylchloride on suitable aliphatic amines and alcohols. The treatment of procaine and nitrogen mustard XXVII with thiophosgene gave the required monoisothiocyanates (XXXI and XXXII).

Unsuccessful attempts were made to synthesize analogs of purine mustard (XIV) containing a purine and having two isothiocyanate groups attached through other groups at positions 6.

3. Results Obtained. The required purine mustards (XIV and XV), quinoline mustards (XVI and XVII) and benzene mustards (XXIV to XXX) were successfully synthesized. A few simple diisothiocyanates were also prepared.

4. Conclusions. Incomplete but promising pharmacological results were obtained with purine mustard (XV) and quinoline mustard (XVI) in mouse leukemia 1210 and Dunning rat leukemia, and with benzene mustards (XXV and XXVI) and an isothiocyanate (XXXII) in Dunning rat leukemia. Microfilm \$2.50; Xerox \$4.00. 71 pages.

#### AN ESTROGENIC STRUCTURE MODIFIED BY THE 2-PYRIDYL RADICAL FOR ANTIANTHEROGENIC ACTIVITY

(L. C. Card No. Mic 60-4323)

William Douglas Dixon, Ph.D.  
University of Kansas, 1960

In an attempt to prepare compounds which possess the cholesterol-lowering action of synthetic estrogens but which lack their feminizing action, sixteen substituted 2-pyridylethanols were prepared by treating 2-benzylpyridine or 2-(4-chlorobenzyl)-pyridine with phenyl lithium and the resulting lithium salt was then allowed to react with the appropriate aldehyde or ketone. In one case where a sufficiently large amount of reactants was employed, two diastereoisomers, DL-isomer A and DL-isomer B, of 1-(2-pyridyl)-1-phenyl-2-(4-methoxyphenyl)-propan-2-ol were isolated.

Ten of the substituted 2-pyridylethanols were reduced to the corresponding 2-piperidinyloethanols in order to determine the effect of this structural change on the pharmacological activity of the substituted 2-pyridylethanols. In addition, the following compounds were synthesized in order to determine the effect of structural changes in 1-phenyl-2-(4-methoxyphenyl)-propan-2-ol (DL-isomer A) on pharmacological activity: 1-(2-pyridyl)-1-phenyl-2-(4-methoxyphenyl)-propan-1-ol, 1-(2-pyridyl)-1-phenyl-2-(4-methoxyphenyl)-propylene (geometric isomer A) and 1-(2-pyridyl)-1-phenyl-2-(4-methoxyphenyl)-propylene (geometric isomer B).

The early pharmacological results have been considered to be sufficiently promising to warrant continued

biological studies in order to select a candidate for clinical trial. Microfilm \$2.50; Xerox \$4.00. 74 pages.

#### CHEMISTRY, PHYSICAL

##### SORPTION AND RETENTION OF AMMONIA BY SOILS AND SOIL MATERIALS

(L. C. Card No. Mic 60-3716)

James Melton Brown, Ph.D.  
North Carolina State College, 1960

Supervisor: William Victor Bartholomew

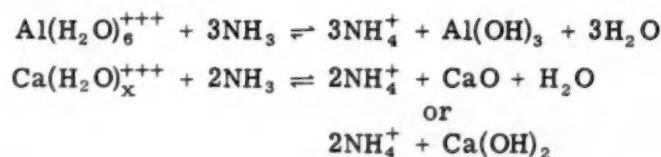
Ammonia sorption and/or retention by soils, soil constituents, and other sorbents was investigated by manometric techniques employing equilibrium measurements in a special glass sorption apparatus. Measurements were made over the ammonia pressure range of 0 to 100 millimeters of mercury and at near atmospheric pressure.

A survey of a number of soils indicated widely different sorption capacities. The sorption capacities of "dry" clays (bentonite and halloysite) as influenced by exchangeable cations followed the order "H"-clay > Al-clay > Ca-clay > Na-clay > K-clay. The order of magnitude of chemisorbed ammonia, i.e., ammonia retained against evacuation, for "dry" bentonite was the same as above with respect to the exchangeable cations.

In view of the relationship between ammonia chemisorption, cation exchange properties, and the nature of the exchangeable cations, it is believed that the chemisorbed ammonia represents that which gains a proton and undergoes exchange reactions with the exchangeable cations and/or that which has reacted with hydroxyl groups on the lattice edges.

The differential chemisorption capacities of "dry" clays as influenced by exchangeable cations are explained on the basis of differences in the degree of hydration of these ions. In the case of  $\text{NH}_4^+$  and  $\text{K}^+$ , which supposedly are not hydrated, "dry" bentonite chemisorbed 0.15 and 0.19 me.  $\text{NH}_3$  per gram, respectively. These values are in accord with the C.E.C. value attributed to lattice hydroxyls of montmorillonitic clays, i.e., 0.2 me. per gram.

Al- and Ca-bentonite chemisorbed 1.01 and 0.79 me.  $\text{NH}_3$  per gram, respectively. The amount of this ammonia in excess of about 0.2 me. is believed to represent that which has undergone exchange reactions with hydrated  $\text{Al}^{+++}$  and  $\text{Ca}^{++}$ . In this connection, the following reactions were proposed:



Because  $\text{Al}(\text{OH})_3$  is more stable than  $\text{Ca}(\text{OH})_2$ , the first reaction would more nearly approach completion. This explains the greater chemisorption capacity of Al-bentonite as compared to Ca-bentonite.



The C.E.C. at pH 7.0 is 0.88 me. per gram for the bentonite used in this study. The addition of 0.2 me. (C.E.C. attributed to lattice hydroxyls) gives a maximum C.E.C. of 1.08 me. per gram, a value in accord with the 1.01 me.  $\text{NH}_3$  chemisorbed by Al-bentonite.

Ammonia sorption by "dry" exchange resins as influenced by exchangeable cations gave further evidence that ammonia was sorbed in some kind of coordinated association with these ions, rather than in a homogenous monolayer as predicted by the B.E.T. equation.

The failure of ammonia to be chemisorbed by synthetic gibbsite was not taken as being evidence against the possibility of ammonia reacting with surface hydroxyls of clay lattices. Gibbsite is basic and the tendency is for  $\text{OH}^-$  and not  $\text{H}^+$  to be dissociated.

A study of the influence of different moisture levels indicated considerable interaction between ammonia sorption and moisture contents. At the lower ammonia pressures, "dry" clays sorbed more ammonia than moist clays. At higher pressures more ammonia was sorbed by moist clays with sorption capacities increasing with increasing moisture contents. Ammonia seemed to compete with aqueous vapor for sorption sites. The same general order of influence of exchangeable cations on ammonia sorption occurred with moist clays as with "dry" clays.

A study of the influence of moisture-aeration treatments on the volatilization of ammonia sorbed by dry soils was conducted. Soils have the ability to retain considerable amounts of ammonia. Dry calcareous Sumter clay retained more of the added ammonia over a 36-day aeration period than either wet or alternate wet and dried Sumter clay. However, in the case of acidic Alamance silt loam, the wet soil retained more of the ammonia, the dry soil being intermediate in ammonia retention.

Microfilm \$2.50; Xerox \$8.20. 176 pages.

#### THE REACTIVITY OF PHENOLS TOWARD FREE RADICALS

(L. C. Card No. Mic 60-4658)

Robert Grant Caldwell, Ph.D.  
University of Hawaii, 1960

The present study may be divided into three main topics: the reactivity of phenols toward polymethyl methacrylate free radicals, the reactivity toward polymethyl methacrylate-peroxy free radicals, and a theoretical study of the structure and reactivity of the phenols and their derived radicals by the semiempirical molecular-orbital method.

#### 1. The Reactivity toward Polymethyl Methacrylate Radicals

The retardation of methyl methacrylate polymerization by added phenols was studied by an accurate dilatometric method. The amount of retardation was found to be very small. Kinetic analysis of the experimental results indicates that the intermediate radicals formed in the reaction between the chain radicals and hydroquinone and 1,4-naphthalenediol disappear from solution principally by

reinitiating polymerization. Comparison with results obtained for retardation by benzoquinone indicates that semiquinone radicals are not formed in the initial reaction of the phenols with the chain radicals. It is concluded that the intermediate radicals produced in phenolic retardation are addition complexes between the chain radical and the phenols. It is shown that the addition complexes might reasonably be expected to be hydrogen-bridged charge transfer complexes.

#### 2. The Reactivity toward Peroxy Radicals

In the presence of oxygen the polymerization of methyl methacrylate is inhibited for a definite period after which polymerization sets in at normal rates. The lengths of the inhibition periods were measured by a simple dilatometric method. In the presence of added phenols, these inhibition periods were lengthened because the interaction of the chain-carrying peroxy radicals with the phenols breaks an oxygen-consuming chain reaction. This chain-breaking allows the oxygen concentration to remain at a level high enough to inhibit the polymerization for a longer time.

In order to derive tractable equations for the kinetic analysis of the experimental results, a novel approach was necessary. The use of average concentrations and average rates during the inhibition periods permitted the derivation of the functional relationship between the lengths of the inhibition periods and the initial concentrations of the phenols.

Kinetic analysis of the experimental results for nineteen phenols yielded values for the relative efficiencies of the reaction between the phenols and the peroxy radicals. Good agreement was found with the results of other workers obtained by different methods for the antioxidation efficiencies of the phenols.

#### 3. Molecular Orbital Theory of the Structure and Reactivity of Phenols

LCAO MO calculations were carried out for several representative phenols and derived radicals as well as for methyl methacrylate monomer and polymethyl methacrylate radical. The results of these calculations were used to discuss the chemical reactivities of the various molecular species.

Theoretical considerations indicate that it is improbable that the initial attack of a peroxy radical takes place on a carbon atom of the phenol. A good correlation was found between the observed reactivities of the phenols and the calculated change in the  $\pi$ -electron energies which accompany the breaking of an O-H bond in the phenols. This provides support for a mechanism involving a strong initial attack on a hydroxyl group of the phenols.

A simple resonance theory was developed in which it was shown that the reactivities of the phenols are correlated with the weight of the resonance structures delocalizing the odd electron in the corresponding aryloxy radicals.

Discussed in the Appendices are: the use of simple LCAO MO theory in the light of current semiempirical SCF MO theory; second-order perturbations of the bonding matrices of conjugated molecules; and secular determinant expansions of substituted aromatic hydrocarbons including a table of the expansions for thirty substituted aromatic hydrocarbons. Microfilm \$2.80; Xerox \$9.90. 216 pages.

**THEORY OF FUSED SALTS  
AND MOLTEN METALS**

(L. C. Card No. Mic 60-3365)

Charles M. Carlson, Ph.D.  
University of Utah, 1960

Chairman: Dr. Henry Eyring

In the introduction some of the different approaches to the theory of liquids are reviewed. The three major ones are the calculation of the configuration integral, the method of partition functions and the use of an equation of state.

Part II presents a new partition function for the alkali halides. It is based on the method of significant structures of Eyring, Ree and Hirai. Theoretical calculations of melting points and boiling points, liquid volumes at the melting point and boiling point, entropies of fusion and vaporization, and critical constants for NaCl, KCl, NaBr, and KBr are in reasonable agreement with existing experimental data.

In Part III a new partition function, also based on the method of significant structures, is presented for the liquid metals. Calculations of the above thermodynamic properties for Na, Hg, Cu, and Pb are in good agreement with observed data. Theories of viscosity and self diffusion are also developed. When these theories are applied, the viscosities and self diffusion coefficients of Na and Hg are predicted in good accord with the observed data.

The fourth section contains a summary of all the equations needed in the calculations along with a detailed description of how to use them.

Microfilm \$2.50; Xerox \$4.20. 80 pages.

**THE MOLECULAR AND VISCOUS EFFUSION  
OF SATURATED VAPORS**

(L. C. Card No. Mic 60-4319)

Keith Douglas Carlson, Ph.D.  
University of Kansas, 1960

This study comprises an investigation of the effusive behavior of saturated vapors over a range of source pressures from  $10^{-6}$  atm in the molecular flow region to 1 atm. Measurements such as these reported have never before been carried out to any comparable extent for saturated vapors. The experiments, which are unusually precise for the methods involved, have yielded new information on the effusive behavior of vapors at source pressures near one atmosphere for the flow of vapor through long channels. They have unequivocally delineated the transition from the molecular to the hydrodynamical effusive behavior for the flow of vapor through a thin-edged orifice. Some theoretical aspects of the question of vapor saturation in a Knudsen cell are considered. The impetus to this investigation is the importance of the effusion method as a thermodynamic tool.

Molecular flow is used extensively in the study of thermodynamic properties of vapor-condensed phase equilibria. Viscous flow under the conditions of small density gradients is used for the measurement of viscosi-

ties. Both of these flow phenomena involve irreversible processes, but the former represents one limiting aspect from which one can derive heats and entropies of vaporization and the latter represents a steady-state process from which one can extract information on intermolecular potentials.

Some limited aspects of these phenomena are investigated. In particular, some aspects of the question of the extent of saturation within a Knudsen cell at low pressures and aspects of the transition from molecular to hydrodynamical effusion under conditions similar to those commonly employed in vapor pressure studies. Specifically, the purposes of this investigation were to clarify the situation regarding the upper pressure limit to effusive flow, to examine the transition of effusive flow from molecular to viscous behavior, and to clarify some limited aspects concerning the question of vapor saturation within an effusion cell.

The question of vapor saturation is considered theoretically. It is shown that a simple but entirely consistent and rigorous analysis from a thermodynamic viewpoint is possible from two assumptions for a limited system under admittedly restrictive conditions. Simple conclusions derivable from this analysis have general applicability within the bounds of the initial specifications. The problem considers a very dilute vapor supplied from the condensed phase and contained within an isothermal enclosure.

The analysis shows the effect of the location of the evaporating surface on the measurable rate of effusion and the dependence of this rate on the geometrical arrangement of the enclosure. It is demonstrated that, aside from thermal restrictions, measurements of the mass transport by beam condensation methods is a more reliable measurement of the vapor pressure than is a measurement of the total rate of effusion. Certain of the irreversible aspects are briefly considered.

The experimental study consists of the measurement of mass flow rates of mercury vapor effusing through a thin-edged orifice or long channels into a vacuum from a region of nearly saturated vapor. Liquid mercury was contained in steel ovens supported on an especially designed vacuum balance. A controller maintained a temperature constancy of 0.25 degree.

The effusion rates of mercury flowing through a thin-edged orifice of 0.02-cm radius are predictable by the molecular effusion formula to a pressure of 0.1 mm. Above this pressure the flow behavior progresses into the hydrodynamical effusion region. The flow behavior for vapor effusing through a circular channel of 0.03-cm radius and 3-cm length is similar to the usual viscous flow behavior but systematically differs from an equation deduced by Knudsen for bilateral effusive conditions. At source pressures near one atmosphere, the flow rate approaches a limiting value corresponding to the effusion of vapor from a nearly saturated channel.

Microfilm \$3.40; Xerox \$11.95. 264 pages.



# THE VAPORIZATION, THERMODYNAMICS, AND PHASE BEHAVIOR OF URANIUM MONOSULFIDE.

(L. C. Card No. Mic 60-4320)

Earle David Cater, Ph.D.  
University of Kansas, 1960

Quantitative investigations of the vaporization of refractory inorganic sulfides are basic to the study of systematic trends in the thermodynamics of vaporization processes and of chemical bonding in gaseous molecules, because of the comparisons which can be made between their results and those for the corresponding oxides. The characterization of the fundamental properties of uranium monosulfide is of interest both from this basic standpoint and from that of its evaluation for possible applications in nuclear technology.

Uranium monosulfide of high purity was prepared by reaction of uranium metal with hydrogen sulfide and subsequent homogenization of the crude product by heating at approximately 2300°K in a tungsten crucible in high vacuum. Uranium samples of natural isotopic composition and of high enrichment in  $U^{235}$  were used, and sulfide samples of various compositions between  $US_{0.80}$  and  $US_{1.07}$  were synthesized.

The vaporization of these sulfides over the temperature range 1840 to 2770°K was investigated by the effusion method. Samples were evaporated from inductively heated tungsten effusion cells, and known fractions of the total effusate were collected on platinum targets which were assayed for uranium by an  $\alpha$ -counting technique. Chemical and x-ray analyses of the solid residues were performed. The composition of the vapor in the temperature range 2100 to 2400°K was studied by means of a time-of-flight mass spectrometer.

Samples of other than one-to-one stoichiometry were found to attain the composition  $US_{1.00}$  on vaporization. The vapor in equilibrium with this solid composition was found to consist chiefly of the gaseous atoms U and S with gaseous molecules US of less, though comparable, importance. At the highest temperatures of the spectroscopic study the gaseous molecule  $US_2$  was barely detectable.

The rate of effusion of uranium-containing species, measured in the target experiments, was expressed in terms of an "effective vapor pressure"  $P_E$ , which when combined with the molecular weight 270.14 gives directly the rate of evaporation of stoichiometric US. An empirical equation fitted by the method of least squares to the data gives

$$\log P_E(\text{atm}) = -1.7382 + 3.1274 \times \frac{10^4}{T} - 1.3181 \times \frac{10^8}{T^2} + 0.093776 \times \frac{10^{12}}{T^3}.$$

The observed volatility varied by a factor of  $10^5$  over the nine hundred degree temperature range, and was about one third that of uranium dioxide at 2300°K.

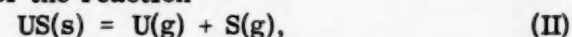
Combination of target and mass spectrometric data yielded the following values by a second law treatment. Both statistical standard deviations and estimated absolute errors are given.

For the reaction  
 $US(s) = US(g),$  (I)

$$\Delta H_{2300}^\circ(I) = 150.3 \pm 1.0 \text{ k-cal/mole (est. } \pm 2.1),$$

$$\Delta S_{2300}^\circ(I) = 38.36 \pm 0.44 \text{ cal/deg-mole (est. } \pm 0.6).$$

For the reaction



$$\Delta H_{2300}^\circ(II) = 271.2 \pm 2.0 \text{ k-cal/mole (est. } \pm 4.0),$$

$$\Delta S_{2300}^\circ(II) = 65.49 \pm 0.88 \text{ cal/deg-mole (est. } \pm 1.6).$$

The corresponding heat of dissociation of the gaseous molecule is 121 k-cal/mole or 5.2 electron volts per molecule, not far less than that for the corresponding gaseous monoxide.

The second law results were combined with published data for the elements to give absolute entropies at 2300°K, respectively for solid and gaseous US, 45.08 and 83.44 cal/deg-mole.

Theoretical considerations yielded the forms of equations expressing the changes of entropy and free energy for the reactions as functions of temperature. The constants were evaluated from the experimental data. For the free energies the resulting equations, which are not valid for extrapolation to low temperatures, are

$$\begin{aligned} \Delta F_T^\circ(I) \text{ (cal/mole)} &= 7.9487 \times 10^6 - 1.0921 \times 10^3 T \\ &+ 0.13212 T^2 + 2.9064 \times 10^6 \log T \\ &+ 6.8635 T \log T, \end{aligned}$$

$$\begin{aligned} \Delta F_T^\circ(II) \text{ (cal/mole)} &= 7.55211 \times 10^6 - 1.22600 \times 10^3 T \\ &+ 0.132119 T^2 + 2.90644 \times 10^6 \log T \\ &+ 2.96503 T \log T. \end{aligned}$$

Other data obtained were the melting point of uranium monosulfide ( $2735_{-5}^{+30}$  °K), its lattice parameter at room temperature ( $5.4903 \pm 0.0002$  Å), and its resistivity ( $100 \pm 30 \times 10^{-6}$  ohm-cm). Schematic phase diagrams were drawn for the systems uranium-sulfur and uranium-oxygen-sulfur, and lattice parameters were obtained for uranium oxysulfide.

Microfilm \$2.50; Xerox \$8.60. 190 pages.

## CHEMISORPTION AND MAGNETIZATION

(L. C. Card No. Mic 60-4747)

Robert Eldon Dietz, Ph.D.  
Northwestern University, 1960

A method has been developed for measuring precisely the magnetization of small samples of ferromagnetic materials over a wide range of experimental conditions. Using this apparatus the saturation magnetization of fine nickel particles having diameters on the order of 100 Å has been investigated as a function of chemisorbed hydrogen. Certain types of preparations of these nickel particles have saturation moments within about 1% that of massive, polycrystalline nickel. The effect of hydrogen on all samples is to diminish the saturation magnetization of the nickel. For unsintered samples this decrease per average atom of chemisorbed hydrogen is  $0.56 \pm 0.09$  Bohr magneton; for sintered samples,  $0.71 \pm 0.04$  Bohr

magneton. The value given for the sintered samples is considered more precise because of the long linear extrapolations to  $1/H = 0$  possible with these larger particles. Arguments are presented to the effect that the degassed surfaces of the nickel are contaminated to no more than a fifth of the total available hydrogen adsorption area, at the onset of an experiment. The decrease in the saturation magnetization of the nickel has been attributed to spin-pairing of the nickel 3d electrons by the bonding electrons of the chemisorbed hydrogen. The results of this investigation were compared with other spin-pairing experiments: copper-nickel alloys, and the system, hydrogen-palladium. From a consideration of the spin-pairing results and the number of states in the 3d and 4s bands, it is concluded that hydrogen is bound to the nickel surface by bonds intermediate between the metallic-type bonds of the nickel, and purely ionic contributions as in the Pd - H system. Since the non-saturation magnetization of a particle depends on its size, extensive studies of the non-saturation magnetization were carried out to determine information concerning particle size, particle size distributions, and other parameters influencing the magnetization curve. The surface areas of these particles calculated from magnetic data is shown to be consistent with estimates of surface area from hydrogen adsorption measurements. To relate the results of the saturation studies to the extensive low field, non-saturation studies carried out by other investigators in this laboratory over the past few years, a phenomenological theory is developed which successfully relates the changes in the low field magnetization to variables such as surface coverage, temperature, magnetic field intensity, and the nature of the distribution of particle sizes. The application of this theory to experimental results demonstrates that the saturation experiments are in approximate agreement with the low-field studies. An important consequence of the theory is that the linearity of the low-field magnetization-volume isotherms indicates that the change in the saturation magnetization is proportional to the number of atoms (or molecules) chemisorbed over the range of coverage for which the isotherm appears linear. It is shown that the magnetization-volume isotherms are in general not linear, but that for small changes in the saturation magnetization, the deviation from linearity is generally within experimental error. Thus any change in the spin-pairing mechanism with coverage should cause an appreciable change in the slope of the isotherm. Suggestions are given for practical tests to insure the validity of the low field experiments and a method is proposed for determining the relative heats of adsorption. Finally, a discussion is given concerning the anomalous "positive effects" observed by Lee and Leak, and previously interpreted as evidence for hydride ion formation. Evidence is presented to the effect that these phenomena result from changes in factors such as the magnetic anisotropy which cause deviations from superparamagnetic behavior. Microfilm \$2.50; Xerox \$7.40. 158 pages.

#### SOLUBILIZATION OF HYDROCARBONS BY POLYISOAPS: A THERMODYNAMIC STUDY.

(L. C. Card No. Mic 60-4230)

Henry Leon Dragun, Ph.D.  
Rutgers University, 1960

Major Professor: Ulrich P. Strauss

Although solubilization has been widely studied, there has been a lack of data that could be thermodynamically interpreted. Two different types of solubiliometers which utilize vapor pressure measurements and yield such data are described in this work. The method was checked by the determination of the vapor pressure of aqueous benzene solutions. The results obtained are in excellent agreement with the literature.

The solubilization of benzene, isooctane, and n-heptane by aqueous solutions of polysoaps were studied at 15°, 25°, and 35° C. The vapor pressure isotherms obtained in these studies showed a negative deviation from Henry's Law. These deviations were similar to those observed with monosoaps but less highly curved. The isotherms also showed: First, the amount of hydrocarbon solubilized was directly proportional to the weight of polysoap in solution; second, benzene was solubilized more than either of the aliphatic hydrocarbons which were solubilized equally well by a polysoap; third, the amount of hydrocarbon solubilized depended on the number of soap groups attached to the parent polymer; fourth, the solubilization of the hydrocarbons studied was independent of temperature over a twenty degree interval. This showed that within the experimental error there was little or no heat of solubilization present. Therefore, the process of solubilization must be due largely to the entropy of the system.

A comparison is also given with results previously obtained for polysoap and monosoap solubilization. In conclusion, the results obtained in this work can be used to test any future theoretical models of the polysoap solubilization process.

Microfilm \$2.50; Xerox \$5.60. 115 pages.

#### ANALYSIS FOR URANIUM BY NEUTRON ACTIVATION AND REACTIONS OF ENERGETIC RECOIL TRITIUM IN SOLVENT MIXTURES

(L. C. Card No. Mic 60-4327)

Larry Allen Haskin, Ph.D.  
University of Kansas, 1960

I. A system has been developed for determining the uranium content of natural limestones and other materials by a neutron activation technique. Isotopes of the mass 133 chain are produced in 6.62% of the thermal neutron fissions of  $U^{235}$ . The final radioactive isotope in this chain is 5.27 day  $Xe^{133}$ ; the analysis is dependent on the isolation and assay of this isotope.

Xenon is obtained in an inert gas fraction by combustion at 700°C. of the irradiated limestone (or other material) with powdered tantalum and with carrier Xenon, thus removing most possible volatile radioactivities except



the inert gases. A chemically pure Xenon Sample is then separated by gas chromatography and condensed with a low temperature gas trap. The Xenon activity is measured by gas proportional assay of the Xenon fraction in the presence of an excess of propane gas. The reproducibility of measurement is about  $\pm 2\%$  and can be used to detect approximately  $10^{-9}$  grams of ordinary uranium. Some activity is always found in the gas phase after irradiation without combustion, from the initial fission recoil and subsequent diffusion. The amount depends on the particle size and must be assayed in each case for accurate results.

Interfering non-inert gases have all been eliminated by the combustion-chromatography separation.  $\text{Ar}^{37}$  from  $\text{Ca}^{40}$  (fast  $n, \alpha$ ) is so abundant that the inert gas separation is required in limestones; in other samples, the gaseous combustion products may be counted directly. Incomplete separation of fission-product  $\text{Kr}^{85}$  will lead to a very long-lived radioactive component in the decay curves. The "apparent" half-life of the  $\text{Xe}^{133}$  will gradually appear longer and longer over the first few months from small amounts of fission product 12 day  $\text{Xe}^{131m}$ .

II. The reactions of  $\text{Li}^6(n, \alpha)$  recoil tritium have been studied in binary liquid solutions. Solutions of acetone-water and acetone-ethanol both show an increasing specific activity of the acetone at low mole fractions. This rise signifies an increased preference for reaction of the tritium with acetone in these solutions. The specific activity of ethanol in acetone-ethanol solutions is approximately constant over all mole fractions. In ethanol-water solutions, a broad shallow minimum appears in the specific activity versus mole fraction plots. The observations are interpreted in terms of competitive reactions of tritium atoms at high kinetic energies.

Microfilm \$2.50; Xerox \$4.20. 78 pages.

STUDIES IN THE HOT ATOM CHEMISTRY  
OF LEAD-212 AND TRITIUM AND  
A TRACER STUDY OF THE NINHYDRIN  
OXIDATION MECHANISM

(L. C. Card No. Mic 60-4330)

Jack Garvin Kay, Ph.D.  
University of Kansas, 1960

1. Hot Atom Chemistry of Tritium. The mechanism of recoil tritium substitution at the asymmetric carbon of L(+)-alanine was investigated in both the crystalline state and in aqueous solution. The  $\text{Li}^6(n, \alpha)$  reaction was used as the source for recoil tritium. After addition of carrier dl-alanine, benzoylation, and separation of the optical isomers, the recovered alanine was degraded to acetic acid. From the specific radioactivities measured for each compound obtained, the amount of D(-)-alanine produced by T for H substitution at the asymmetric carbon of L(+)-alanine was determined.

In these experiments all of the D(-)-alanine produced from L(+)-alanine could be accounted for by racemization occurring during benzoylation and prior to chemical resolution. It was concluded that T for H substitution proceeds with complete retention of configuration at an asymmetric

carbon in the crystal and occurs in aqueous solution for only 0.01% of the total tritium. Substitution in the adjacent methyl group proceeds with retention of configuration in more than 85% of the events.

2. A Tracer Study of the Ninhydrin Oxidation of Alanine. The mechanism of the oxidative degradation of  $\alpha$ -amino acids by ninhydrin was investigated to determine the role of the hydrogen attached to the  $\alpha$ -carbon of the acid. Using dl-alanine labeled with recoil tritium, it was determined that ninhydrin oxidation to acetaldehyde resulted in only a minor exchange and loss of tritium from the  $\alpha$ -carbon position. The small loss observed could be accounted for by exchange reactions occurring during formation of acetaldehyde-2,4-dinitrophenylhydrazone or acetaldehyde dimedone before counting.

Further experiments using non-tritiated alanine in HTO resulted in negligible radioactivity in the acetaldehyde following the ninhydrin reaction. It was concluded that the  $\alpha$ -hydrogen of the amino acid remained non-labile throughout the degradation reaction. A reaction mechanism that is consistent with these observations and those of other workers in similar systems is suggested.

3. Hot Atom Chemistry of  $\text{Pb}^{212}$ . Investigations were conducted to determine whether or not  $\text{Pb}^{212}$  recoiling from alpha decay of  $\text{Po}^{216}$  could undergo substitution reactions in the gas phase. Using thoron swept from aqueous thorium nitrate as a source of  $\text{Po}^{216}$ , it was determined that volatile lead compounds were produced by recoil in the presence of gaseous hydrocarbons, hydrogen and argon, but not in pure helium. The yields in pure hydrogen, while detectable, were quite small. The yields in 90% Ar-10%  $\text{CH}_4$  and in 100% Ar were nearly double the yields in 100%  $\text{CH}_4$ , while the yield in 90% He-10%  $\text{CH}_4$  was less than 5% of that for  $\text{CH}_4$ .

The nature of the volatile compounds was not determined, but it was found that  $\text{Pb}(\text{CH}_3)_4$  was not present in detectable amounts. The products could be condensed with liquid  $\text{N}_2$  and re-volatilized. They decomposed or reacted slowly at room temperature to give non-volatile lead, and they reacted partially with  $\text{O}_2$  at 1% concentration.

It is felt that ionization potentials and metastable electronic states may play important parts in the reaction mechanism. Enhanced yields in the presence of argon are believed to be due to sensitization by the rare gas. Dialkyllead and mixed alkyllead hydrides are considered possible reaction products in the hydrocarbon atmospheres.

Microfilm \$2.50; Xerox \$4.60. 90 pages.

THE TRI-IODIDE COMPLEXES OF AMYLOSE  
AND CERTAIN OTHER POLYMERS.  
EQUILIBRIUM AND SPECTRAL STUDIES.

(L. C. Card No. Mic 60-3089)

Emmanuel G. Kontos, Ph.D.  
Columbia University, 1959

The tri-iodide complexes of amylose, polyvinyl alcohol and cyclohexaamylose, the alpha-Schardinger dextrin, were studied spectrophotometrically in aqueous solutions at 25°C, and it was found that the tri-iodide ion,  $\text{I}_3^-$ , is the ligand, or complexing agent, in all cases.

The molecular extinction coefficient of the absorption

of the  $I^-$  ion at 2265 Å was found to be  $1.3 \times 10^4$ . Studies with this absorption band indicate the removal of  $I^-$  ion, as well as of  $I_2$ , from the system amylose-iodine-iodide.

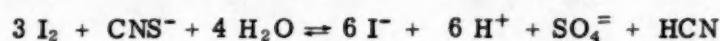
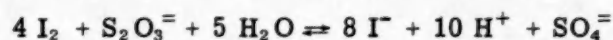
The amylose-tri-iodide complex,  $AmI_3^-$ , absorbs at 3530 Å, at the same wave length where the free  $I_3^-$  ion absorbs. The molecular extinction coefficient of the  $AmI_3^-$  complex at 3530 Å, based on the molar concentration of  $I_3^-$  bound, was found to be  $(1.08 \pm 0.08) \times 10^4$ , and for the absorption at 6250 Å, which is responsible for the blue color of the complex, was found to be  $(2.81 \pm 0.22) \times 10^4$ .

Two characteristic isosbestic points were discovered in the neighborhood of 2600 Å and 3050 Å for the amylose-tri-iodide system.

The addition of  $IO_3^- + H^+$  in an amylose-iodine solution decreases the intensity of the 6250 Å and 3530 Å absorption bands of the complex, due to the oxidation of  $I^-$  to  $I_2$  and consequently the elimination of the  $I_3^-$  ions from the solution. Similar behavior was observed with decrease of the pH of an amylose-iodine solution, due to the suppression of the  $I^-$  ion formation from the hydrolysis of iodine.

Varying systematically the ratio of  $(KI)/(I_2)$  in a solution with constant gram atoms of iodine and amylose concentration, it was found that the maximum percent absorption at 6250 Å corresponds to the maximum tri-iodide ion concentration, and consequently the maximum complex formation.

The reduction of  $I_2$  to  $I^-$  by  $Na_2S_2O_3$  and KSCN do not follow the expected stoichiometric reactions for low  $I^-$  concentration, i.e., about  $10^{-6}$  molar, and in the presence of excess of iodine. In fact, they appear to be



and for the maximum  $I_3^-$  concentration, calculated on the basis of the above equations, maximum percent absorption at 6250 Å is also observed.

The addition of neutral salts, like  $MgSO_4$  and  $KCl$ , in an amylose-iodine solution, increases considerably the intensity of the two bands of absorption at 6250 Å and 3530 Å, of the amylose-tri-iodide complex.

The polyvinyl-borate-tri-iodide complex absorbs at 6800 Å as well as at 3530 Å, and shows the same spectroscopic characteristics as the amylose-tri-iodide complex.

The cyclohexaamylose-tri-iodide complex absorbs at 2880 Å and 3530 Å, and was found to have the same extinction coefficients as the free  $I_3^-$  ion, at the same wave lengths.

By rapidly freezing in liquid nitrogen an aqueous solution of iodine in potassium iodide, at a temperature in the neighborhood of  $-24^\circ C$ , a blue color of the same hue as the one observed in the amylose-tri-iodide complex appears. The development of V and F color centers in an amylose-tri-iodide solution at room temperatures is considered. The two color centers V and F are responsible for the ultraviolet and visible absorption of the  $AmI_3^-$  complex, respectively.

Microfilm \$2.50; Xerox \$5.60. 114 pages.

#### SOLVENT CHARACTERISTICS OF TETRAMETHYLENE SULFONE: A NEW HAMMETT $H_-$ FUNCTION.

(L. C. Card No. Mic 60-4772)

Cooper Harold Langford, III, Ph.D.  
Northwestern University, 1960

Research Supervisor: Prof. Robert L. Burwell, Jr.

The solvent characteristics of tetramethylene sulfone- (sulfolane) have been examined. The compound melts at  $28.9^\circ C$ . and has a very large cryoscopic constant (66.2 deg./mole). Sulfolane should be very useful for molecular weight determination. Hydrogen bonding solutes were studied cryoscopically. Water was dimeric over the concentration range 0.01 to 0.1 molal; methanol was partially associated. The vapor pressure of water over sulfolane-water solutions was greater than Raoult's law predicts by factors of 2 to 3.

The dielectric constant of sulfolane is 44 and its viscosity is 0.0987 poise. The electrical conductance of some salts in sulfolane was studied.  $LiNO_3$ ,  $NaCNS$ , and dimethylmorpholinium iodide appear to be weak electrolytes, but tetraphenylarsonium chloride and phenyltrimethylammonium iodide are completely dissociated. Furthermore, equivalent conductance appears to be nearly independent of concentration for these last two salts.

A Hammett  $H_-$  indicator acidity function was evolved for sulfolane-water mixtures using phenyltrimethylammonium hydroxide as the base.  $H_-$  was evaluated between 14 and 20 and acidity constants of some weak organic acids were determined. It was shown that  $H_-$  is governed in this system both by increase in hydroxide activity (decreasing solvation) and by decreasing water activity. The former is the more important factor, but the two may be varied separately over small ranges.

Sulfolane proved to be a good solvent for polar and polarizable compounds including aromatic compounds, unsaturated hydrocarbons, a few simple salts, and a wide range of inorganic complexes.

Microfilm \$2.50; Xerox \$5.40. 109 pages.

#### THERMODYNAMIC PROPERTIES OF REFRACTORY BORIDES: PART I: EVAPORATION BEHAVIOR AND VAPOR PRESSURE OF ZIRCONIUM DIBORIDE. PART II: PHASE STUDIES IN THE TANTALUM- BORON SYSTEM BETWEEN Ta AND TaB.

(L. C. Card No. Mic 60-4332)

James Maclean Leitnaker, Ph.D.  
University of Kansas, 1960

Thermodynamic properties of refractory borides are becoming of increasingly greater interest as high-temperature materials become important in both industrial and military technological applications. A very meager amount of such data is presently available. This study deals with the vapor pressure of zirconium diboride and with phase relationships of the tantalum-boron compounds  $Ta_{2.4}B$ ,  $Ta_3B_2$  and  $TaB$ . Both the zirconium-boron system



and tantalum-boron system seem of potentially great importance.

Vapor pressures of zirconium over zirconium diboride in a tungsten crucible have been measured by the Knudsen technique over the temperature range 2150°K to 2475°K. A new type of apparatus was constructed and used successfully in the study. Reaction of the solid boride with residual gases in the system producing volatile oxides was investigated and measured pressures were corrected for the increased volatility. Several different orifice sizes were used and the data therefrom used to obtain an evaporation coefficient of  $0.025 \pm 0.010$ . Zirconium diboride is believed to vaporize to the gaseous atoms with a Third Law  $\Delta H^\circ$  of  $458.3 \pm 6.5$  kcal/mole and an associated entropy change of  $98.4 \pm 2.0$  eu. The inconsistency between the observed value and the calculated value of 477.7 kcal/mole can be explained on the basis of inconsistencies in the heat of vaporization of metallic zirconium.

Phase studies of the solid portion of the Ta-B system were made between Ta and TaB. Two intermediate phases were found:  $Ta_{2.4}B$  (referred to as  $Ta_2B$  in the literature) and  $Ta_3B_2$ . Both have narrow ranges of homogeneity.  $Ta_{2.4}B$  is stable only at high temperatures, decomposing at  $2040^\circ \pm 30^\circ C$  to Ta and  $Ta_3B_2$ .  $Ta_3B_2$  is the low-temperature stable phase, decomposing above  $2180^\circ \pm 20^\circ C$  to  $Ta_{2.4}B$  and TaB. Rates of reactions of the elements and of intermediate phases were investigated; these rates are believed responsible for errors in the work of previous investigators.

Microfilm \$3.50; Xerox \$12.15. 269 pages.

#### ON THE MECHANISM OF OXIDATIVE SCISSION IN NATURAL RUBBER

(L. C. Card No. Mic 60-5022)

Andrew Mercurio, Ph.D.  
Princeton University, 1960

When natural rubber is exposed to molecular oxygen at elevated temperatures, a number of important chemical changes occur including scission of the rubber molecules. Although the oxidation involves a well understood radical chain reaction, the mechanism of scission has not been elucidated. In particular, scission has not been associated with any of the steps of the chain reaction.

To study scission, the free radical producers 2-azobisisobutyronitrile, di-*t*-butyl peroxide, and benzoyl peroxide, have been used to initiate the oxidation of natural rubber in dilute benzene solutions. Quantitative comparisons are made between the measured rate of rubber scission and the known rate of initiation of oxidation by these agents under these conditions. It is found that one scission occurs for each initiating radical produced. This result is independent of rubber concentration in accord with the first order spontaneous cleavage and high initiating efficiency of the initiators used. This is interpreted to mean that scission occurs in the termination step of the chain reaction. A chemical mechanism for scission is proposed. Conversely, the rate of rubber scission in dilute benzene solutions, and in solid rubber has been used as a method to investigate the ability of the systems tetramethyl thiuram disulfide and benzoyl per-

oxide-dimethyl aniline to initiate radical processes. For these agents, it is found that the rate of initiation depends strongly on rubber concentration. In solid rubber, the rates of initiation are comparable to the rates of initiation of polymerization by the systems in bulk styrene and in bulk methyl methacrylate.

Scission of natural rubber networks (vulcanizates) has also been investigated. For such networks, a very simple and widely used method of following scission reactions is the measurement of stress decay in elongated samples. Experiments have been conducted to establish whether oxidative stress decay is truly a measure of the random cleavage of network chains or whether, as some workers have suggested, the rather sparse cross-linked sites (introduced during vulcanization) are preferentially cleaved by molecular oxygen. The rate of oxidative stress decay in a series of five rubbers of different chemical structures has been measured. Each rubber was cross-linked by sulfur and by a non-sulfur containing agent. Among the sulfur cured samples the rate of stress decay varies very significantly with the basic rubber structure in spite of the presence of sulfur cross-links in each. On the contrary, for natural rubber, GR-S, and butyl rubber, the stress decay of the sulfur cures is not very different from that of the corresponding sulfurless cures. This behavior must be due to the cleavage of network chains in these cases. The slight differences in stress decay between various natural rubber samples can readily be accounted for by the effects produced by impurities in the form of excess curing chemicals and products thereof.

Another quantitative proof that scission occurs along network chains and not at the cross-linked sites has been obtained by preparing a set of natural rubber vulcanizates cross-linked to different extents by high energy electrons. The extent of cross-linking could be determined by two independent methods. This method of cross-linking does not introduce impurities. By analysis of the stress decay curves for these samples it is found that the rate of scission is independent of the degree of cross-linking. Furthermore the rate of scission so measured is the same within 50 per cent as the rate of scission determined for unvulcanized rubber in benzene solution. Clearly the same oxidative scission of polyisoprene chains is involved.

The same radical reactions which produce scission may in certain cases also produce oxidative cross-linking. By applying both continuous and intermittent stress decay methods to radiation vulcanizates it is observed that natural rubber undergoes only scission reactions. The related emulsion polymerized polybutadiene and all *cis* 1,4 polybutadiene exhibit both oxidative scission and oxidative cross-linking. For sulfur cures of the above, there is superposed on the oxidation reactions a continued vulcanization caused by remaining curing agent.

Microfilm \$2.50; Xerox \$4.20. 77 pages.

# THE INFRARED SPECTRA AND STRUCTURES OF SOLID CYANOGEN AND CYANOGEN HALIDES

(L. C. Card No. Mic 60-3675)

John William Nebgen, Ph.D.  
University of Pennsylvania, 1960

Supervisor: Dr. Eugene R. Nixon

The infrared spectra of crystalline cyanogen and of crystalline cyanogen chloride and cyanogen bromide have been investigated, as well as various mixed crystals (solid solutions) of cyanogen chloride and cyanogen bromide. All spectra were recorded at 80°K.

The only fundamental vibration of the cyanogen molecule in the crystal which appears in the infrared spectrum is  $\nu_3$  at 2165  $\text{cm}^{-1}$ . The intensity of this band is only about 1/20 of that of the corresponding band in the gas. A number of combination bands are observed. Since the crystal structure of cyanogen has not been reported, a comparison of the observed spectrum with one predicted using the cubic carbon dioxide crystal as a model for the cyanogen structure is made. There is good agreement in the comparison. Recent x-ray diffraction measurements on the cyanogen crystal at 153°K indicate that the structure is orthorhombic with four molecules per unit cell. The predicted spectrum using this crystal is at variance with the observed. The possibility of two different structures of cyanogen at the two different temperatures (80°K and 153°K) is suggested.

The crystal structures of cyanogen chloride and cyanogen bromide indicate that they are isomorphous with one another. Within the crystals, the molecules are oriented in long parallel chains with the halogen atom of one molecule overlapping the nitrogen atom of its neighbor. Using this long chain model, two equations in four unknown force constants were set up involving the two stretching frequencies  $\nu_1$  and  $\nu_3$  of the XCN molecule. Two other equations in the unknown force constants were set up using the observed  $\nu_3$  frequencies for the  $\text{XC}^{13}\text{N}^{14}$  and  $\text{XC}^{12}\text{N}^{15}$  molecules isolated in long chains of ordinary molecules. The force constants are  $F_1$  and  $F_2$ , the stretching force constants for the X-C bond and the C-N bond respectively;  $F_{12}$ , an intramolecular coupling force constant; and  $F'$ , an intermolecular force constant coupling the stretching of the X-C bond of one molecule and the stretching of the C-N bond of its neighbor. For BrCN,  $F_1 = 4.02 \times 10^5$ ,  $F_2 = 17.30 \times 10^5$ ,  $F_{12} = 0.25 \times 10^5$ , and  $F' = -0.019 \times 10^5$  dyne/cm. In the case of ClCN, only three frequencies are available to calculate four force constants. However, in BrCN,  $F'$  is independent of  $F_{12}$ . If  $F_{12}$  is set equal to zero, three equations can be solved for  $F_1$ ,  $F_2$  and  $F'$  in ClCN. Treating  $F'$  as a constant, the same three equations can be solved again for  $F_{12}$  and for better values of  $F_1$  and  $F_2$ . The final results are for ClCN;  $F_1 = 5.25 \times 10^5$ ,  $F_2 = 17.28 \times 10^5$ ,  $F_{12} = 0.38 \times 10^5$ , and  $F' = -0.021 \times 10^5$  dyne/cm. These were then used to calculate  $\nu_1$  in ClCN which is not seen.  $F'$  is treated as a dipole-dipole interaction from which it is concluded that the bond moment derivatives of the X-C bond and the C-N bond must have the same sign in the crystal.

The infrared spectra of various mixed crystals (solid solutions) of ClCN and BrCN are discussed and compared to the spectra of the pure components. It is found that the

frequency shifts with dilution of the fundamental vibrations  $\nu_1$  of BrCN and of  $\nu_2$  of BrCN and ClCN are dependent upon the logarithm of the mole fraction of the component in question. The frequency shifts are interpreted as changes in the resonance structures I  $\text{X} - \text{C} \equiv \text{N}$ , II  $\text{X}^+ = \text{C} = \text{N}^-$  and III  $-\text{X}^+ - \text{C}^- = \text{N}^-$ . The relative intensity per molecule of the  $\nu_1$  band of BrCN and of the  $\nu_2$  bands of BrCN and ClCN are measured and plotted against mole percent. It is found that the intensity per molecule reaches a maximum at about 50 mole percent and then decreases with increasing concentration.

Microfilm \$2.50; Xerox \$5.20. 104 pages.

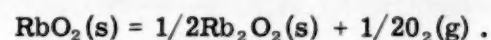
# THE THERMAL DECOMPOSITION OF RUBIDIUM SUPEROXIDE

(L. C. Card No. Mic 60-4665)

Americo William Petrocelli, Ph.D.  
University of Rhode Island, 1960

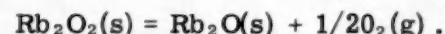
The thermal decomposition of rubidium superoxide has been studied in the temperature range of 280°C to 360°C. The studies were carried out in a pyrex glass high vacuum system. A specially designed and constructed torsion balance for "in situ" vacuum weighings was employed to determine the change in composition of the decomposing superoxide.

The results show conclusively that the oxide,  $\text{Rb}_2\text{O}_3$ , does not form in the course of the thermal decomposition of the superoxide, and that there is no solid solution formation between the decomposing superoxide and the peroxide product. The reaction path is, thus, established to be:



The thermodynamic properties,  $\Delta H^\circ$ ,  $\Delta C_p^\circ$ ,  $\Delta S^\circ$ ,  $K_p$  and  $\Delta F^\circ$  have been calculated for the above reaction.

The thermal decomposition of the peroxide was studied in the temperature range of 300 to 360°C. The thermodynamic properties, listed above, have also been determined for the reaction:



Experiments carried out with potassium superoxide have served to clarify the discrepancies existing in the literature concerning the thermal decomposition of this compound. Microfilm \$2.50; Xerox \$4.40. 82 pages.

# STRUCTURES AND PHASE RELATIONSHIPS IN THE MOLYBDENUM OXYGEN SYSTEM AND THE HIGH TEMPERATURE VAPORIZATION BEHAVIOR OF MOLYBDENUM DIOXIDE

(L. C. Card No. Mic 60-4336)

Ernest Roland Plante, Ph.D.  
University of Kansas, 1960

A study of the phase relationships in the molybdenum oxygen system in the temperature range 400-800°C was carried out. Samples of known O/Mo ratios were heated in evacuated or helium filled vycor tubes for periods ranging from a few hours to over a month. The product

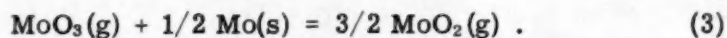
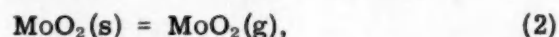
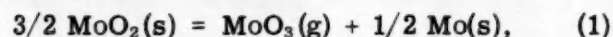


from the reaction was examined microscopically and by single crystal and powder x ray diffraction techniques.

Equilibrium conditions were frequently not obtained. It is assumed that migration of  $\text{MoO}_3$  into cooler regions of the reaction tube, the formation of a phase in a metastable state as an intermediate in the reduction of  $\text{MoO}_3$  or oxidation of  $\text{MoO}_2$ , or incomplete reaction is responsible for the non-equilibrium products. A phase diagram which is considered likely to represent the phase behavior in the composition region  $\text{MoO}_2$ - $\text{MoO}_3$  was proposed on the basis of the present study and data in the literature.

A partial structure determination of monoclinic  $\text{Mo}_4\text{O}_{11}$  was performed using single crystal data and Fourier methods. The molybdenum atom positions obtained are in good agreement with the results of a concurrent, independent investigation.

An extensive study of the vaporization behavior of molybdenum dioxide was carried out in the temperature range 1590-2030°K. All observations can be accounted for in terms of the three reactions;



Total vaporization experiments showed that the amount of  $\text{MoO}_2(\text{g})$  leaving a molybdenum Knudsen cell is small unless the lid of the crucible is much hotter than the sample and there is significant leakage of vapor through the crucible-lid junction. Reaction (3) is endothermic, and the formation of orifice deposits and transport of Mo from a hot lid are shown to result from a displacement of reaction (3) to the right at a hot lid.

Modified Langmuir experiments were carried out in an alumina crucible in order to estimate the importance of  $\text{MoO}_2(\text{g})$  in the vaporization process by condensing it on the cool lid of the alumina crucible and determining the rate at which the lid gained weight. A lower limit to the  $\text{MoO}_2(\text{g})/\text{MoO}_3(\text{g})$  ratio of about 0.01 and an upper limit to the heat of reaction (2) was obtained by the third law method assuming an entropy change of 45 eu.

A thermodynamic treatment of the molybdenum transport phenomena was carried out by assuming that equilibrium conditions were attained in the vicinity of the sample at temperature T and the lid at  $T' > T$ . It is shown that the observed molybdenum transport can be accounted for using reasonable temperature gradients. A value of  $128 \pm 9$  k cal is obtained as the most likely heat for reaction (2) on the basis of the modified Langmuir experiments and the observed Mo transport.

Measurements of the vapor pressure over solid  $\text{MoO}_2$  and Mo using a molybdenum effusion oven and the target technique were carried out in the temperature range 1592-1918°K. The sublimate was assayed for Mo by a colorimetric method and all Mo on the target was attributed to condensation of  $\text{MoO}_3(\text{g})$ .

Measured pressures using different orifice areas showed the vaporization process to be diffusion controlled. Steady state pressures are obtained rapidly, and further decrease in the volatility is slight.

The data are treated in several ways, and the agreement between the heats obtained by the several methods is good. The best values for the heat and entropy change of reaction (1) are  $\Delta H_T^\circ = 123.4 \pm 0.7$  k cal. and  $\Delta S_T^\circ = 49.4 \pm 0.4$  eu.

The results of previous investigators on the vaporization of molybdenum dioxide are in error because the importance of reaction (3) was not recognized.

Microfilm \$3.55; Xerox \$12.40. 273 pages.

#### THE AMINE-CATALYZED DEALDOLIZATION OF DIACETONE ALCOHOL IN NON-AQUEOUS SOLVENTS

(L. C. Card No. Mic 60-3680)

Walter John S. Polestak, Ph.D.  
University of Pennsylvania, 1960

Supervisor: John G. Miller

The rates of the amine-catalyzed decomposition of diacetone alcohol have been studied dilatometrically in anhydrous solvents at 30°. The first-order velocity constants were evaluated graphically by the Guggenheim method. These constants show dependence on the medium; for example, the amine-catalyzed reaction takes place only in hydroxylic solvents. Reactions that occurred in methanol, isopropanol and n-butanol did not take place in n-heptane, chloroform and carbon tetrachloride. Infrared and ultraviolet studies in the inert solvents, that considered both the aldolization and dealdolization reactions, also revealed no reaction taking place. The following systems did not react: triethylamine in n-heptane; pyridine in n-heptane; triethylamine in chloroform; diethylamine in n-heptane; and finally, n-butylamine in n-heptane.

It was found that the rate of reaction in methanolic solutions of n-butylamine and its hydrochloride, and dimethylamine and dimethylamine hydrochloride, at constant ionic strength and constant buffer ratio, increases linearly with increasing buffer concentration. The intercept on the rate axis for zero concentration falls at the origin for both systems. This clearly shows there is molecular catalysis by the primary and secondary amine and that the contribution due to the methoxide ion is negligible in these systems. The molecular catalytic constants for n-butylamine and dimethylamine were calculated from the slope and found to be  $4.24 \times 10^{-2} \text{ min.}^{-1}$  and  $6.91 \times 10^{-3} \text{ min.}^{-1}$ , respectively.

A probable mechanism for the catalysis by a secondary amine is presented. It involves the addition of the secondary amine across the carbonyl group of diacetone alcohol and the splitting out of acetone without the formation of water.

The catalytic constant for the methoxide ion was obtained from solutions of sodium methoxide, which were brought to constant ionic strength by the addition of sodium chloride, in methanol. The molar rate constant for catalysis by the methoxide ion is  $6.51 \times 10^{-2} \text{ min.}^{-1}$ .

Reaction takes place in solutions of trimethylamine and triethylamine in anhydrous methanol. However methanolic solutions of trimethylamine and trimethylamine hydrochloride, at constant ionic strength and constant buffer ratio, did not provide the necessary evidence to indicate the catalytic nature of the reaction. The volume changes for these buffered solutions were so unusually small and the rate so low, that no definite conclusion could be drawn.

Microfilm \$2.50; Xerox \$5.60. 111 pages.

THE INFLUENCE OF DOUBLE LAYER  
STRUCTURE ON THE ADSORPTION ISOTHERM  
OF PALMITIC ACID

(L. C. Card No. Mic 60-3991)

Robert Francis Scarr, Ph.D.  
University of Illinois, 1960

The capillary activity of palmitic acid at a stationary mercury electrode was to be investigated by constructing the adsorption isotherm by means of double layer capacity measurements at various potentials. Such data would permit later interpretation of capacitance measurements for a monolayer of oriented organic molecules. The influence of double layer structure, which is a function of supporting electrolyte concentration, was also to be studied. The double layer is composed of both an inner and a diffuse region, for each of which a unique capacitance may be defined. It is the present hypothesis that these two capacitances must be distinguished in calculating adsorption isotherms.

An a.c. impedance bridge which operated on the off balance principle was constructed to facilitate observation of the extremely slow approach of the capacitance to an equilibrium value. The characteristics of an unbalanced bridge were discussed with respect to conditions necessary for optimum sensitivity. A hanging mercury drop electrode was used to provide a reproducible, renewable surface of known dimensions.

The double layer capacity and surface charge density as a function of potential and concentration were determined for mercury in contact with aqueous  $\text{NaClO}_4$  as the supporting electrolyte. Sodium perchlorate is adsorbed on the electrode surface at potentials anodic to the electrocapillary maximum by being "squeezed" out of solution. A method based on kinetic and thermodynamic theories of the double layer was devised for calculating the quantities and distributions of charged species present in case the potential of the electrocapillary maximum is lacking.

The double layer capacity of the mercury microelectrode was measured as a function of palmitic acid concentration at various potentials in the region of maximum capacitance depression, -0.5 to -0.8 volt versus SSCE. The slow attainment of equilibrium was expedited by mechanical stirring, but this procedure caused the occurrence of a minimum in the time dependent behavior of the capacitance. No definite conclusions regarding this effect could be reached. Instantaneous readjustment of the capacitance following shifts of the polarizing potential within the range -0.5 to -0.7 volt indicated identical coverage of the electrode in this region.

Because of the unavoidable presence of surface active contaminants, the capacitance was found to decrease slowly with time even in the absence of palmitic acid. This drift was empirically compensated using an expression derived by assuming simple competition between a single contaminant and the palmitic acid. The calculation of the empirical correction parameters was based on using values of the capacitance of the inner region of the double layer. Although the form of the empirical expression is similar to a Langmuir isotherm, the large uncertainties involved tend to disqualify the results from having physical significance. Nevertheless, the effect of the diffuse double layer on the isotherms may be investigated relatively independently of experimental errors.

Both the total and the inner double layer capacities corrected for contaminants were calculated from data for each set of experimental variables. These variables were: potential, supporting electrolyte concentration, and palmitic acid concentration. The calculated values for each type of capacitance were plotted according to both ordinary and reciprocal Langmuir plots. These plots show that even for solutions saturated with palmitic acid, complete coverage of the surface is not achieved. Although palmitic acid may be regarded as intrinsically highly surface active, the limitations of solubility prevent achieving saturated monolayers.

Comparison of the slopes of the Langmuir plots permits evaluation of the influence thereupon of the diffuse double layer. It is found that corresponding slopes can differ by as much as 43%. It is therefore concluded that the customary practice of neglecting the diffuse double layer in the characterization of adsorption isotherms is not altogether exact. However, in specific instances, compensating effects render the results valid.

Microfilm \$2.50; Xerox \$5.00. 96 pages.

PARTICLE SIZE CONTROL  
IN EMULSION COPOLYMERIZATION

(L. C. Card No. Mic 60-5214)

Tito T. Serafini, Ph.D.  
Case Institute of Technology, 1960

Processes are described for the synthesis of styrene-butadiene copolymer latexes of very uniform particle diameters. Uniformity is accomplished by restricting the particle nucleation stage of the process to the low conversion period so that later stages of polymerization can equalize the sizes of a limited number of particles. The most certain way to limit the degree and time of nucleation is through the utilization of soaps having a limited capacity for micellization even when used in quantities sufficient to stabilize the latex particles. New data for the critical micelle concentration of lithium soaps demonstrate that lithium salts of fatty acids have unique solubility properties which provide a self-regulating mechanism for control of micellar nucleation of new polymer particles. Variation of the lithium ion concentration exerts a control on the number of soap micelles, and hence on the number of latex particles nucleated.

This theory and technique for controlling uniformity and size is applicable only to systems in which micellar nucleation is the locus of particle formation. When one of the monomers is water soluble, as in the styrene-acrylonitrile system, both aqueous phase and micellar nucleation seem to occur simultaneously.

Microfilm \$2.50; Xerox \$3.60. 64 pages.



**RECOIL-TRITIUM REACTIONS  
WITH SOME SOLID ORGANIC ACIDS**

(L. C. Card No. Mic 60-4340)

Raymond Milford White, Ph.D.  
University of Kansas, 1960**ASSAY OF RADIOACTIVITY OF  
TRITIUM-LABELED COMPOUNDS BY  
GAS-PROPORTIONAL COUNTING**

Condensed-phase organic compounds are quantitatively assayed for tritium activity by zinc fusion, followed by gas-proportional counting the resulting volatile products. Optimal conditions include paraffin, as a source of hydrogen carrier, in the combustion mixture. Gas-proportional counting is best accomplished using C.P. propane as a supporting gas at 40-50 cm. Hg pressure. Oxygen and oxygen-containing gases seriously interfere with counting plateaus. This method of analysis is applied to a wide variety of organic molecules with an accuracy of  $\pm 1\%$ .

**REACTIONS OF RECOIL TRITIUM  
WITH UNSATURATED ACIDS**

Recoil-tritium atoms substitute into all of the hydrogen positions of crystalline cis- and trans-cinnamic acid, benzoic acid, and sodium trans-cinnamate. The specific activities of the different positions in these compounds, as determined by molecular degradation, indicate a preference for tritium substitution on the aromatic ring. The aromatic activity generally decreases in the order: ortho > para > meta. The ortho activity in cis-cinnamic acid shows about a 50% deficiency, which may be due to steric interference by the -COOH group.

Recoil-tritium replacement of non-labile hydrogen in maleic and fumaric acids is accompanied by geometric cis-trans isomerization in less than 5% of the substitu-

tions. Addition to a double bond, as determined by the yield of succinic acid from maleic and fumaric acids, is about half as frequent as substitution for hydrogen in the parent molecule. A similar probability ratio for tritium addition to aromatic substitution is observed at the triple bond in phenylpropionic acid. Of the cinnamic acid produced by tritium addition to phenylpropionic acid, more than 90% is in the trans form. Reactions of recoil-tritium are postulated which occur at high energies and involve a minimum of atomic motion.

**REACTIONS OF RECOIL TRITIUM  
WITH SUBSTITUTED BENZOIC ACIDS**

Recoil tritium atoms react with substituted benzoic acids to form tritiated benzoic acid when the substituent group is -NH<sub>2</sub>, -NO<sub>2</sub>, -OH, -COOH, -F, -Cl, -Br, and -I. The relative amount of radioactivity bound as benzoic acid to parent molecule ranges from 2% for m-aminobenzoic acid to 58% for o-iodobenzoic acid. The ease of displacement increases rapidly as the bond energy of the substituent to the aromatic ring decreases.

Intramolecular degradation of the benzoic acids shows most of the tritium substitutes into the position of the substituent. About 10% of the benzoic acid activity is found at the position adjacent to that formerly occupied by the substituent; generally, less than 5% is found two positions removed. Similar results are obtained in the aniline isolated from irradiated aminobenzoic acid.

The sensitivity of benzoic acid yield to bond energy implies that chemical bonding is much more important than the physical mass of the bonded atoms or groups in determining the chemical fate of a recoil-tritium atom. This sensitivity also implies that the energy at the time of reaction, while well in excess of thermal energies, is probably in the range of a few electron volts.

Microfilm \$2.50; Xerox \$5.80. 120 pages.

## ECONOMICS

### ECONOMICS, GENERAL

#### THE ECONOMICS OF MUNICIPAL ZONING

(L. C. Card No. Mic 60-4598)

Otto Anderson Davis, Ph.D.  
University of Virginia, 1960

A municipal zoning law can be defined as an ordinance which divides a community into districts according to allowable uses of property. It deals with the uses of land and buildings, population density, the height and bulk of buildings, lot size, and the proportion of a lot which a building may cover.

Zoning finds its economic justification in the fact that external diseconomies exist in the urban property market, and the purpose of zoning is to "adjust" or "correct" the working of the price mechanism in urban property in order to allow for the presence of these external diseconomies. Zoning tries to accomplish its purpose through the democratic imposition of four separate types of regulation upon what an individual may do with his property. These are: (1) use regulations, (2) height regulations, (3) space regulations, and (4) area regulations.

In the absence of zoning or any similar restrictions, economic analysis indicates that the introduction of an external diseconomy causes a reduction in the market value of those properties "directly" affected and may result in the creation of a pecuniary external economy upon those properties "indirectly" affected. The expectation of the occurrence of external diseconomies, granted certain assumptions, will result in the construction of structures with a smaller number of square feet of floor space, a smaller capital outlay on urban property, and the failure to develop sites that would be developed in the absence of the danger of external diseconomies.

External diseconomies of any great importance in urban property can occur only when ownership is broken up into "small" tracts. Ownership of "large" areas "internalizes" external effects. This fact implies that external diseconomies will not occur in the subdivision process if the subdivision is of a "sufficient" size.

Classification of external effects suggests that there are six possible combinations, and of these two are relevant for zoning. While this classification does not measure the extent to which external diseconomies can be expected to occur, it does indicate that, in areas of the metropolis where ownership is broken up into "small" tracts, external diseconomies can be expected to arise.

Although a beneficent planner with dictatorial powers would face a difficult task in drawing up a zoning ordinance, it is probable that he could identify some of the uses and features which create external diseconomies for each of the various "types" of urban property, and, granted this fact, he could so zone that the probability of the occurrence of an external diseconomy would be decreased. Thus it can be inferred that in theory zoning can be a step toward the

Pareto optimum in urban property, with the exception of the case in which internal factors (cost and demand) are such that compensation could be paid. In this instance application of welfare criteria indicate that zoning's segregation method might result in an "inefficient" allocation of resources.

However, zoning restrictions are chosen democratically through the political process. If individuals are motivated by self interest in the political arena, and if they have the knowledge to understand whether or not any given set of zoning restrictions will be favorable or unfavorable to them, the political process will result in an ordinance which will eliminate external diseconomies in some instances but actually will create them in other instances. In addition, an ordinance resulting from such a democratic process might not allow individuals in some cases to redevelop their property in the manner they desire even if no external diseconomies were created. These facts plus a classification of individuals by interests indicate that zoning cannot be said to "push" a municipality toward the Pareto frontier in urban property.

While economic analysis indicates what the effects of zoning could be, "political" analysis indicates that these results are likely to be compromised. Under our present institutions, the question of whether to zone or not to zone does not afford a happy choice.

Microfilm \$2.50; Xerox \$8.40. 183 pages.

#### THE "FREE" PUBLIC ROAD AND GOVERNMENT HIGHWAY POLICY DECISIONS

(L. C. Card No. Mic 60-4611)

Charles Owen Meiberg, Ph.D.  
University of Virginia, 1960

The purpose of this discussion is to present an explanation, in the language and method of the economist, of what is an essentially political process -- the provision of highways. In the nineteenth century, there developed in the United States the idea that public roads should be provided "free" to all who desired to use them. With the advent of the automobile, there has also developed what society has come to recognize as a "highway problem." It is a contention of this paper that this problem, insofar as it is characterized by traffic congestion or inadequate facilities, is the result, in part at least, of the continued acceptance of the concept of the "free" road.

Because those ideas prevailing in a society at a point in time are the result of history, Part One is devoted to the development of the "free" road concept in the United States. Chapter II presents the historical background of highways and illustrates the significant role played by private turnpike companies in highway development in the early nineteenth century. Chapter III discusses (1) the decline of the



turnpikes following the development of more efficient means of transportation and (2) the evolution of the "free" public road, which is pictured as a result of the historical accident by which the railroad was developed prior to the automobile. Chapter IV reviews the "good roads" movement of the later 1800's and shows how the pressures of this movement led to a renewed participation in highway development by the states and the federal government. The highway policies of these governments are then brought up to date to illustrate how the concept of the "free" road is still embedded in these policies.

Part Two develops a model for analyzing the "highway problem." Highway transportation is seen to be a unique service, resulting from the combination of both private inputs (vehicles, fuel, etc.) and public inputs (highways). But because the supply of highway services has not been strictly responsive to changes in the price (user taxes), ordinary supply and demand analysis is not adequate. It is suggested that congestion has been looked upon as an undesirable element of highway transportation which governments should eliminate. Because of the prevailing predilection for "free" roads, efforts to reduce congestion have been directed towards increasing the supply of highways. Yet the inability of governments to provide congestion-free roads is shown as a result of a misunderstanding regarding the quantity of highway services demanded and the quantity actually consumed. On the other hand, congestion, rather than an explicit price, is viewed as the factor which leads to the attainment of an economic equilibrium. Because of congestion, a given highway system is capable of increasing (to a certain extent) the quantity of highway services it can provide. And, congestion operates to restrict demand in much the same way as user taxes. Some congestion may, therefore, be not only useful but also desirable. But if this is so, the present description of the "highway problem" may be incorrect.

The results of this study point to the need for a reconsideration of (1) the continued allegiance to the "free" road concept and (2) the existing characterization of the "highway problem" as a problem of congestion. It is suggested that congestion is undesirable only insofar as it fails to influence individual behavior properly. The real "highway problem" may be more appropriately described as one of resource allocation where external effects are present. Congestion may then be viewed in its proper prospective, as an alternative means of increasing the physical capacity of the highway system.

Microfilm \$2.50; Xerox \$8.40. 183 pages.

CAUSAL FACTORS UNDERLYING THE  
RELATIONSHIP BETWEEN WAGE RATES  
AND JOB CONTENT IN THE INDUSTRIAL FIRM

(L. C. Card No. Mic 60-4810)

Warren Clayton Waterhouse, Ph.D.  
Northwestern University, 1960

Supervisor: Elmo P. Hohman

The study is concerned with an examination of the wage and job structure of a single firm in the foundry industry to determine the effects of technological change on the wage structure.

It was recognized that numerous forces act upon a company wage structure to determine its form and to narrow or widen the skill differentials. The wage structure represents an attempt to establish an internally consistent system of wage rates while at the same time conforming to the going rates of the community or industry. Thus, the interplay of supply and demand for labor is constantly influencing the positions of the different occupations. Internally, the principal force determining the shape of the wage structure is the inherent value of the individual occupations. Changes in technology associated with the occupations will usually change the worth of the jobs and consequently the wage rates.

It was postulated in the study that relative skill differentials have been narrowing in most industries for more than 50 years; and while technological change is a characteristic of the industry the nature of its relationship to changes in the wage structure is not clearly defined.

The proposition is advanced that: 1) the changes in the rank order of occupations in the wage structure and changes in the number of positions and the number of persons at different skill levels are primarily attributable to technological change; and 2) that the wage rates of the more skilled jobs have increased at a slower pace than have the rates of the lesser skilled jobs largely because of non-technological forces.

The specific objectives were: 1) to show the evolutionary nature of the effect of technological change on wage-job relationships over a period of years; 2) to call attention to observed wage patterns and trends; 3) to evaluate the findings in the light of their contribution to the theory of wage determination; and 4) to develop an index that would satisfactorily measure the degree of mechanization associated with each occupation.

A medium size firm in the steel foundry industry was selected for examination because it appeared to closely meet the following requisites which were established for the study: 1) a substantial number of workers employed in the industry; 2) longevity of the process in the basic field; 3) stability of both product and process; 4) cost of labor as a relatively large part of the value added by manufacturing; and 5) a significant, though not revolutionary, change in technology during the period under study.

The four foundry departments selected had performed clearly defined functions for more than thirty years prior to the last year used in the study. To insure comparable characteristics and uniform measurement of change, production and maintenance occupations below the level of supervisor were selected.

The specific years, 1942 and 1954, were selected after considering that: 1) the foundry had been organized with the same labor union during both years; 2) the foundry had available a substantial backlog of unused labor until approximately 1940; 3) the period between the two years was one of generally rising wage rates; 4) the foundry made significant technological changes during the intervening period; and 5) two formal job evaluations had been completed during the period.

To accomplish the objectives of the study, the following procedure was used. 1) The characteristics and nature of technological change were examined as they existed in the foundry and the industry. 2) An index was developed for measuring the degree of mechanization associated with each occupation. 3) The degree of mechanization was determined for each occupation in 1942 and 1954 and compared with changes in the size of the workforce in each

year. 4) The change in the skill mix of the workforce was compared with the relative change in the mechanization index values of the occupations. 5) The change in total job values and skill differentials was compared with changes in the mechanization index of each job. 6) Finally, the factors making up the content of each job was examined to learn the nature of any changes directly attributable to technology. Microfilm \$4.60; Xerox \$16.20. 358 pages.

## ECONOMICS, AGRICULTURAL

### THE STRUCTURE OF THE U. S. MEAT INDUSTRY

(L. C. Card No. Mic 60-4145)

George Lowell Baker, Jr., Ph.D.  
Purdue University, 1960

Major Professor: Charles E. French

The objectives of this study were to determine the structure and forces of structural change in the meat industry. The procedure used was to review secondary sources and reaffirm or temper these findings through interviews with representatives of firms within the meat industry, trade associations, publications, the government, and colleges. The meat industry includes all firms which handle livestock or meat from production to consumption. These firms are classified into institutions: retailers, wholesalers, meat packers, marketing agencies, and producers.

The structure of the meat industry changed considerably from 1920 to 1960. The most significant periods of change were 1920-1930 and 1942-1952. These were periods when forces both largely exogenous to the industry and those endogenous to it were most strongly exerted. Exogenous factors such as governmental action, technological change, improvements in transportation and communications, general economic environment, population expansion, and changes in consumer tastes and preferences have greatly affected the industry. The degree to which these exogenous factors affected the various institutions in the industry, of course, differed in any one period of time and changed through time.

The endogenous factors including changes in merchandising policies, changes in buying procedures, desire for growth, availability of capital, changes in type of establishment, changes in functions performed, and integration within the industry, also differed by institution and through time. The relative influence of these factors on the marketing institutions changed.

The most significant changes in the meat industry have been changes in meat retailing. These changes included increases in the proportion of meat consumption that was purchased in grocery stores, growth in size of grocery stores and store organizations, and decline in the number of grocery stores. Fifty percent of the meat purchased by grocery meat buyers was purchased by buyers representing a relatively large group of stores. The grocers exerted their influence on other firms and institutions in the meat industry chiefly through specification buying.

Changes in meat retailing have forced changes in meat wholesaling. Meat wholesalers formerly were predominantly suppliers to independent grocery stores. As the number of independent grocery stores declined or independent grocers purchased meat directly from packers or through their grocery wholesalers, the need for meat wholesalers diminished.

For meat packers to provide the meat purchased by group grocery buyers, packers had to meet the specifications prescribed. These specifications usually included U. S. grade rather than a packer grade. Thus, after widespread adoption of U. S. grades, independent packers were able to sell meat comparable to meat of national packers. Also, as independent packers in general specialized in slaughter operations, had better utilization of plant and equipment, had fewer labor problems, lower labor costs, and less governmental surveillance than larger packers, sales volumes of independent packers increased relative to national packers.

In order that packers could obtain livestock which would in turn meet retailer specifications, packers increased the proportion of their purchases directly from producers. The proportion of livestock moving through terminal, local, and dealer markets declined.

In general, concentration at all levels of the industry has increased. The most significant change in concentration has been the increased concentration in meat retailing relative to meat packing. Vertical integration has also increased but not to a great extent. Even with these increases in concentration and vertical integration, the ability of any one firm or group of firms arbitrarily to set prices seems rather remote.

The meat industry is becoming an industry of essentially two (retailer and packer) marketing institutions rather than four (retailer, wholesaler, packer, and marketing agency). The changes in concentration and integration have changed the functions performed and the role played by firms making up the meat industry.

Microfilm \$3.30; Xerox \$11.50. 254 pages.

### AN INVESTIGATION OF THE EFFECTS OF VARYING RATES OF INFLATION AND DEFLATION ON AGRICULTURAL PRICES AND INCOMES

(L. C. Card No. Mic 60-4152)

Curtis Hoover Braschler, Ph.D.  
Purdue University, 1960

Major Professor: Paul L. Farris

Farm prices and incomes declined during the 1950's in spite of the growth and prosperity of the general economy. The accumulation of farm surpluses amounted to around nine billion dollars by 1960 as a result of government price supporting programs.

The deteriorating state of agriculture during the 1950's has been attributed to a number of factors. The more important have been identified as follows:

1. Rapid increases in production relative to increases in consumer demand.
2. Deterioration of agricultural export markets.
3. Declining secular income elasticity of demand for food.



4. Relative greater income elasticity of demand for marketing services attached to food than for food itself.
5. A highly inelastic price elasticity of demand for food at the farm level.

This study was designed to determine whether another factor other than those mentioned above might have contributed to the lower farm prices and incomes during the 1950's.

Specifically, it was hypothesized that increases or decreases in consumer income could have different effects on farm prices and incomes depending on the rate of change of prices and economic activity per unit of time. During rapid periods of change in prices and economic activity, the effect of changes in consumer incomes on farm price and incomes could be greater than during periods of slow change in prices and economic activity. During rapid periods of change, the cost of marketing farm products tends to move sluggishly relative to changes in the general level of prices and consumer income. The increase or decrease in agricultural prices and incomes resulting from increases or decreases in consumer income, therefore, tends to be accentuated during periods of rapid change. But during slow periods of rise in prices and economic activity, marketing costs tend to be relatively more flexible upward, thus absorbing increases in consumer income which could have increased farm prices and incomes.

The period from 1913 through 1958 was classified into years of slow and rapid change in prices and economic activity. Time series data for the period were analyzed using multiple correlation and regression models. The following major conclusions appeared evident as a result of the analysis:

1. Consumers spent a relatively constant proportion of their current income for food at the retail level during the period from 1913 through 1958.
2. During the period of slow change the cost of marketing farm products absorbed a significantly larger proportion of increases in consumer income than during the period of rapid change.
3. This resulted in significantly greater changes in current farm prices and incomes relative to changes in consumer incomes during the rapid change periods than during the slow change periods.
4. The income elasticity of demand for food during the 1950's appeared to be about the same as that for the slow change years of 1913 through 1915 and 1922 through 1929.
5. The cost of the added marketing services attached to food during the 1950's appeared to have been more than offset by improvements in marketing efficiency. The total food marketing bill during the 1950's was less than the predicted food marketing bill, assuming the same relations between the food marketing bill and consumer income that existed during 1913-1915 and 1922-1929.
6. The chronically depressed state of agriculture during the period from 1953 through 1959 was partially the result of a transition of the economy from a period of rapid change to a period of slow change in the general level of prices and economic activity.

Microfilm \$2.50; Xerox \$7.40. 159 pages.

## FACTORS AFFECTING CONSUMER BEHAVIOR IN FOOD SHOPPING

(L. C. Card No. Mic 60-4155)

Alfred Joseph Burns, Ph.D.  
Purdue University, 1960

Major Professor: Richard L. Kohls

Increased emphasis has been placed on work with consumers by the Agricultural Extension Service. The primary objective of consumer food education programs is to educate the consumer in the economics of food consumption. This will tend to make marketing firms more competitive by reducing imperfections in the marketing system and will tend to improve dietary and nutritional levels. In order to give direction to extension education programs in food and food marketing it is necessary to have an understanding of the interest, problems, and behavior of consumers. With this in mind the following objectives were outlined for this study:

1. To determine the relative responsiveness of consumers to certain types of information which may be included in a consumer education program in food and food marketing.
2. To analyze consumer responsiveness in terms of motivational implications for a consumer education program.
3. To determine consumer knowledge and behavior patterns and to analyze these for implications for consumer education programs.
4. To determine food buying interests and problems of consumers and to analyze these for implications for consumer education programs.

Methodology was as follows: A survey was made of a panel of Lafayette, Indiana, homemakers four times within a one-year period. Data were obtained to determine responsiveness to motivational subject matter topics, to determine consumer knowledge about several food purchasing aspects, to determine the amount of preparation for shopping, to determine the amount of food store loyalty, and to determine problems and interests of consumers.

Responsiveness to five subject matter topics was studied. These topics included information regarding quality, nutrition, price convenience, and new and different products. Consumer knowledge of five food purchasing aspects was studied. These aspects were: knowledge about the price of food items purchased, knowledge of the best buy in different sizes of eggs, knowledge of the nutritional difference between Grade A and Grade B eggs, knowledge of brands and grades, and knowledge about size of canned goods purchased. Two types of preparation for shopping were studied. These were general information reading and purchase planning.

With the current trends toward higher family and per capita incomes, larger families, higher education levels, and increased numbers of retired and aged people, indications are that in the future consumers will have a greater interest in quality, nutrition, convenience and new and different information, but a lower interest in price information.

It appears that a consumer food program must use the multiple motivational approach if large groups are to be reached, as a homemaker is usually highly interested in only one or two motivational topics. High interest topics are generally not clustered around the same homemakers, but specialized interest groups tend to stand out in responsiveness to certain motivational topics.

Probably the easiest group to reach through mass media with a consumer food program is already the better informed group, while less informed homemakers are harder to reach with a program. The less informed homemakers do very little or no reading about food in magazines or newspapers. This leads us to doubt the efficiency of newspapers and magazines as a media for a food program.

Indications are that we cannot depend upon an education program being developed from a basic need for food information shown by homemakers. Homemakers feeling they needed food information most were generally the better informed homemakers. A program developed from their needs would probably not be very interesting to the less informed homemakers.

Microfilm \$3.55; Xerox \$12.40. 273 pages.

**OPTIMUM ENTERPRISE ORGANIZATION  
FOR SOUTHERN MICHIGAN SPECIALIZED  
DAIRY FARMS (INCORPORATING AVAILABLE  
NEW TECHNOLOGY)**

(L. C. Card No. Mic 60-3411)

William Mack Crosswhite, Ph.D.  
Michigan State University, 1960

Major Professor: James Nielson

Specialization and adoption of new technology have forced dairy farm operators to make important farm or organizational changes. In view of present trends, it appears that specialization in dairy production will continue to be favorable for a large number of dairy producers.

This thesis is directed toward situations in which new technology is being introduced on dairy farms. The primary task of this study is to outline a number of farm plans which will be helpful and useful to farm families considering the feasibility of making organizational changes arising from the incorporation of the new technology available in milking, feeding and housing.

Several techniques for determining efficient farm organizations are available. Functional analysis and linear programming are employed in this study. Functional analysis is employed in evaluating present dairy farm organization for a sample of forty-four Southern Michigan dairy farms. Cobb-Douglas functional analysis is used in deriving estimates of marginal value products.

Linear programming is employed in evaluating the profitability of using the new technology available in milking, feeding and housing. Recent adaptation of linear programming techniques to farm planning has made it possible to examine systematically the relative profitability of various combinations of enterprises and production possibilities.

The results of the functional analysis carried out for a

total of forty-four Southern Michigan dairy farms suggest that the average dairy farm is organized along the scale line. Further, increasing returns to scale are being realized for the sample farms. These increasing returns to scale suggest that dairy farm operators should enlarge their farm operations, at least within the range of the data in the derived production function. The larger farms were organized around a combination of approximately 300 acres of land, 30 months of labor and milking approximately 50 cows.

A modified linear programming procedure was used in which the supply of operating capital was variable; that is, the supply of capital was allowed to vary continuously from zero to an unlimiting amount. The study of relationships which exist for changes in the amount of limited resources of land, labor and operating capital gave the following results for both stanchion and loose housing arrangements:

1. Increasing the amount of operating capital brought about a more adequate utilization of land and labor resources.
2. Increasing the amount of land increased the relative importance of the grain selling activity except for situations with a large number of cows and a resulting low labor requirement for each animal unit.
3. An increase in the amount of labor resulted in an increase in the relative importance of the dairy enterprise.
4. Important changes in the optimum farm plan resulted from changes in either land, labor or operating capital.

The use of a loose housing system resulted in the following changes:

1. Increased operating capital requirements.
2. A larger number of cows in the optimum farm plan for a given level of operating capital.
3. With unlimiting operating expenses, the optimum farm plan included the purchase of large amounts of forage.
4. A minimum of \$7,000 increase in investment capital in milking parlor, milking equipment and housing were required in converting to loose housing.
5. Only small increases in returns to land, labor, capital and management.

The increase in the number of cows resulting from reduced labor requirements could have a number of important effects if loose housing is adopted in a large area such as Southern Michigan. The most important of these is a large increase in the output of milk and a resulting large decline in the price of milk. A second important effect suggested by the programming results is the need for improved cropping practices and improved forage harvesting methods; and, a third important effect is the large increase in capital investment required to incorporate the new technology. Microfilm \$2.50; Xerox \$6.60. 136 pages.



## THE PAPALOAPAN DEVELOPMENT PROJECT

(L. C. Card No. Mic 60-3826)

Thomas Theobald Poleman Jr., Ph.D.  
Stanford University, 1960

The central purpose of the study is to describe and, in so far as is possible, evaluate the agricultural aspects of the regional development scheme currently being undertaken by the Comisión del Papaloapan in the Papaloapan river basin of southeastern Mexico. The Comisión, a semi-autonomous, multi-purpose agency of the federal government, was created in 1947 with powers to "dictate the disposition of industrial, agricultural, and colonization matters in so far as they pertain to the integral development of the Papaloapan basin." The development scheme therefore is not exclusively an agricultural one, but, as the basin's resources and economy are predominantly agrarian, it is largely so oriented.

The agricultural phase of the scheme warrants particularly close investigation in that it embodies the first major attempt by the government to stimulate farm output in Mexico's humid tropical regions. Generally regarded as the country's greatest reserve of potentially arable land, these regions, because of isolation, disease, and an unpleasant climatic environment, have hitherto supported only a small population and a spotty or very extensive type of agriculture. The experiences of the Papaloapan project, as a result, can not avoid having a weighty influence over the nature and direction of future governmental activities to hasten their development.

The study falls into three parts, each of which, while logically forming part of the whole, stands as a unit in itself. In the first, the importance of the project to Mexico's future is outlined against a backdrop of the country's relatively meager agricultural resources and its rapidly increasing population. In the second, the physical and human resources of the basin are described, its economy as of the outset of the project is reviewed, and, following a description of the Comisión as an agency to promote economic change and of the events leading to its creation, the objectives and accomplishments of the scheme through 1956 are examined.

The contents of the final section reflect the fact that the project is still uncompleted. Ideally, the concluding chapters would have been given over to a comprehensive appraisal of the effectiveness of the various means employed by the Comisión to encourage agricultural development and of the project's eventual contribution to the basin's economy. However, as the scheme had been only about one-third completed by the end of 1956, the cutoff date employed, any such evaluation was out of the question. Indeed, because the Comisión has been confronted with so many unknowns in the execution of the agricultural phase of its program, it had not as then been able to formulate more than a highly tentative plan of agricultural development, and this in terms far too general to warrant precise appraisal.

Nevertheless, it was not too early for a few of the pilot projects from whose operations the detailed mechanics of the agricultural program were to be drawn to have accumulated a valuable backlog of experience. Nor was it too early for this experience to be utilized as the basis for some preliminary conclusions regarding the several approaches tested. The third and concluding section is

therefore devoted to a description and evaluation of the three major pilot ventures - two of them involving colonization (Los Naranjos and Michapan), the other credit (Valle Nacional) - which the Comisión had undertaken by 1956. From their experience, some lessons are inferred with respect to the most desirable course of the Comisión's future activities.

Though the Papaloapan area is rapidly becoming one of the best documented regions of Mexico, the study draws heavily on unpublished material. During the summer of 1954 and the autumn of 1956, the writer was afforded the opportunity for field-work in the basin. During these visits he was granted full access to the many unpublished studies and reports in the Comisión's files and also the privilege of discussing the development program with most of the agency's key officials.

Microfilm \$4.45; Xerox \$15.55. 345 pages.

LAND USE IN OHIO: TRENDS, PROSPECTS  
AND EVALUATION.

(L. C. Card No. Mic 60-4124)

Robert Moffett Reeser, Ph.D.  
The Ohio State University, 1960

Land use in Ohio is characterized by diversity of both patterns and rates of change. Rapid increases in population have led to problems of supersession of agricultural land by urban uses. Agriculture has been unable to compete effectively against more intensive (urban) uses for the land base of its operations. Since population growth prospects indicate increased future demand for food, more land will be required for food production.

The objectives of this study were to develop an analytical framework of the changes in land use, to determine the probable characteristics of the land use pattern of the future, to formulate a criterion or standard against which a land use pattern could be measured, and to evaluate the allocation of land resources by a comparison of projected patterns and ideal patterns.

Long-time (1900-1955) trends in land use were analyzed by fitting straight line trends to census data for Ohio and for three relatively homogeneous sub-areas. In northwestern Ohio, the extent of cropland was found to be increasing in spite of a small decline in land in farms. In southeastern Ohio, the area of land in farms was found to be declining rapidly. The area of forest land has increased by the reforestation of retired submarginal farmland. In northeastern Ohio, a highly urbanized area, an extremely rapid reduction in land in farms was noted. Speculation in land for non-farm development, changing requirements for different urban land uses, and the low agricultural opportunity cost of land were factors. The future patterns resulting from projection of trends for Ohio showed total land in farms being reduced, but with a slight increase in acreage of intertilled crops. Non-farm land increased from 6.1 million acres in 1955 to 7.4 million in 1975 and 9.4 million acres in 2000.

An "ideal" land use plan was formulated by projecting population and by applying desirable per capita rates of land use. Agricultural needs were projected, as the area required, to provide the same proportion of per capita

food needs, with some adjustment in diet and improvement in crop yields. Aggregation of components showed insufficient land in Ohio, for the projected population, and assumed ideal land use rates for 1975 and 2000.

A compromise land use plan was developed utilizing "a highest and best use" approach in which agricultural land was residual. In this plan the deficiency in agricultural land is 560 thousand acres in 1975 and 7.4 million acres in 2000. To meet this deficiency by increasing crop yields, an annual increase of 1.7 per cent would be needed to 1975 and 4 per cent from 1975 to 2000. Needs for non-farm land of 2.8 million and 4.2 million acres in 1975 and 2000 were indicated, but trends showed that 7.4 million and 9.4 million acres would be allocated to non-farm use by the free-market mechanism. To offset the sharp curtailment of land for agricultural production and at the same time keep pace with population increase, a 5.5 per cent annual increase in yield index would be required from 1975 to 2000.

Conclusions, drawn on the basis of the assumptions made, were that a shortage of land for agricultural purposes would develop about 1975. To alleviate the ultimate conflict between increase in consumers of land resources and the amount of land available, these means were suggested: adjustments in the allocation of land between uses, intensification of use, changes in diet, agricultural regional specialization, and importation of food from other areas or states in the nation. Finally, population controls are seen as inevitable if a man-land ratio incorporating desirable rates of land use is to be maintained.

Microfilm \$3.15; Xerox \$10.60. 234 pages.

#### EFFICIENCY IN COTTON MARKETING WITH SPECIAL EMPHASIS ON COUNTY MARKETING PROGRAM ADJUSTMENT

(L. C. Card No. Mic 60-3430)

Almer Wayne Woodard, Ph.D.  
Michigan State University, 1960

Major Professor: Lawrence W. Witt

The objectives of this study were to assist Henderson County leaders in planning the marketing segment of a program of agricultural development and to establish procedures suitable to aid county marketing program planning and conduct. The program projection concept of doing extension work provides the vehicle through which the program may be conducted. Increased efficiency in the marketing system is the goal of the program. Techniques for measuring efficiency of the present system and instituting change are involved in the program adjustments.

Program expansion of county marketing work depends upon the assembly of data showing potential gain from suggested changes. Form and time aspects of pricing efficiency provide the basis for examining efficiency at the producer level.

Form efficiency in the cotton market can be evaluated through comparison of the product being marketed with that resulting from reasonable adjustment. A net county income increase of more than \$15,000 could be effected by changing seed stocks alone.

Pricing efficiency can be improved in the producer selling operation based on the 1957 observations. Ginners bought 53 per cent of the cotton but only one per cent was bought on official grades. Ginner grades averaged out the actual grade differences between lots where value differences amounted to one-fourth of the cotton value.

The analysis of time aspects of pricing efficiency revealed that growers were marketing at the desirable time. Price increases derived from holding the cotton for a delayed marketing date would not have offset carrying costs.

Educational work in cost analysis with cotton ginners can be done by comparative analysis and through break-even analysis. Comparative analysis permits measurement of the individual gin costs against the county or state averages. This encourages self-inspection by the firm.

In measuring efficiency of the present ginning system a model gin was designed to meet the requirements of the area. Average total costs per bale, at a volume of 2880 bales, were somewhat less than costs for existing gins.

Cost analysis of the existing gins revealed that in 1957 total ginning costs amounted to about \$15.49 per bale.

Fixed costs per bale for the model gin were higher than for existing gins, indicating that additional volume would further increase the cost advantage of the model gin. Cost items varied considerably between gins, emphasizing that cost groups are subject to some cost control by management.

Break-even analysis offers to ginners a technique that facilitates cost and returns planning. A statistically derived variable cost function per bale described the county gin cost structure. By accepting this as the county standard, individual ginners can readily compare their operations with the county average. The use of this function in break-even analysis permits the ginner to use break-even techniques in managerial planning with more precision than can be achieved graphically.

It was concluded that the program with producers can be conducted within the framework of what, when and where to sell. Producer action may be measured against standards of the state or producing area. The County Planning Committee can aid marketing efficiency development by encouraging producers and ginners to use the tools of analysis available and by suggesting standards of performance.

Recognition is given to the need for a study of total resource use in Henderson County. Such a project would have assumed priority over this study had all possible projects been ranked in order of importance to the county.

Microfilm \$2.50; Xerox \$6.20. 130 pages.



## ECONOMICS, COMMERCE-BUSINESS

## THE ECONOMIC STRUCTURE OF CHANNELS OF DISTRIBUTION

(L. C. Card No. Mic 60-4742)

Louis Pierre Bucklin, Ph.D.  
Northwestern University, 1960

The concept of the channel of distribution has played an important part in the development of marketing thought during the past fifty years. During this period of time, a considerable amount of empirical work has been done to define the kinds of institutions to be found in channels, to determine which kinds are found in which channels, and to discover costs of operation. Despite much merit in this work, comparatively little consideration and effort have been devoted to the study of why certain types of channels emerge and whether existing channels will be subject to change in the future.

One of the reasons for the lack of such effort is the absence of any general theoretical framework to serve as a basic guide. The purpose of this dissertation is to determine whether this void can be filled by constructing such a needed framework upon the logic of the modern economic theory of the firm.

In order to bring the logic of economic theory to bear upon the study of channel structure, it was first necessary to identify the characteristics of the types of work that the firm would be called upon to perform. This was accomplished by a modification of the familiar functional concept in marketing. Use of this concept permitted certain basic blocks, or types, or work to be outlined. These were termed persuasion, search, inventory, transit, and production.

The theory of the firm was then analytically applied to the operation of these functions to determine how many blocks of work would be required to handle a given product, and whether each block would be performed by a separate firm or whether some would be operated jointly. The number of such functions required, and the degree of integration among them, was defined as the structure of the channel.

The kinds of forces affecting the structure of the distribution channel were studied by an analysis of the operation of functions in five different, abstract, and progressively more complex market conditions. These conditions may be characterized as 1) modified perfect competition, 2) modified pure competition, 3) monopolistic competition caused by spatial differentiation, 4) monopolistic competition caused by product differentiation, and 5) oligopoly. The various channel structures developed in each of these environmental studies were termed normative in character. The normative channel may be considered that channel which will exist when all the institutions are fully adapted to the economic forces at work.

Two results accrued from this analysis. First the examination of the different market environments permitted a series of relationships among the five functions to be delineated. These relationships dealt with the basic ways by which the functions were fitted together to form channel structures for different products. They also considered the impact of various market forces upon the extent of integration of the functions.

The second result was that the formation of the norma-

tive concept of a channel created a methodology that permitted critical analysis of existing channel structures. By comparing an actual channel with some estimate of the normative structure, one may derive a measure of understanding of the economic forces at work. This will, in turn, permit the prediction of channel structures that will prevail in the future, provided there are no social or political barriers to economic change.

Microfilm \$3.45; Xerox \$12.15. 266 pages.

## THE THEORY AND APPLICATION OF DIRECT COSTING

(L. C. Card No. Mic 60-3914)

Philip Eugene Fess, Ph.D.  
University of Illinois, 1960

Accounting is a dynamic field which is in a continual process of refinement and improvement as demands for more useful financial data are made upon it by the many users of accounting data. The proper treatment of manufacturing costs has been a topic of discussion among accountants for years. Direct costing is the most recent development in this area.

Since the introduction of the concept of direct costing into the accounting literature in 1936, much discussion has taken place concerning the merits of direct costing and the conventional costing concept. The aim of this dissertation is to study the underlying theory and the application of direct costing.

The wide interest shown in direct costing has resulted in considerable difference of opinion as to the definition of direct costing. At the outset a historical background of the treatment of manufacturing costs, the nature of direct costing, and the definition of direct costing are considered. The preliminary material also includes a discussion of the variety of terms used to describe the concept generally referred to as direct costing as well as the numerous terms used to describe the basic fundamentals of direct costing: fixed and variable manufacturing costs.

Following these introductory considerations the basic differences between direct costing and conventional costing as well as the accounting procedures, financial statements, and theoretical basis of both direct costing and the conventional costing concept are described. The advantages and disadvantages of direct costing, derived from the accounting literature and from discussions with some users of direct costing, are discussed in considerable detail and are subjected to a critical analysis. The study also includes a statistical summary of the present day use of direct costing.

The dissertation concludes that the major advantages of direct costing is the ease with which financial data relevant for many management uses can be extracted from the accounting records maintained under direct costing. Direct costing aids short-run production planning, cost control, cost-volume-profit analysis, short-run credit policy, and short-term cash planning. In brief, direct costing provides valuable financial data for management uses for much short-run planning and decision making. The major disadvantages of direct costing are that direct costing is not in accordance with generally accepted accounting theory

for the preparation of published financial statements and is not acceptable to the Internal Revenue Service, the Securities and Exchange Commission, and the New York Stock Exchange. In addition, direct costing fails to provide management with much pertinent financial data for long-run production planning and decision making.

Since absorption costing is required for published financial statements it seems logical that this conventional costing concept should be used in the formal accounting records. This restricts the use of direct costing to an internal function. It is a decision for the individual business to make whether or not the use of direct costing justifies the cost of employing this concept in an internal role as a supplement to the generally accepted concept of manufacturing cost as required for published financial statements. In other words, the cost system should provide the relevant data for both internal and external uses. Direct costing is another tool for the accounting tool kit for use as part of a cost system aimed at meeting the ever-increasing demands for more useful accounting data.

Microfilm \$3.80; Xerox \$13.30. 294 pages.

**THE DEVELOPMENT OF THE  
LABOR-MANAGEMENT STATUTE  
OF 1959: A STUDY OF ORGANIZATION,  
POLITICS, AND POWER.**

(L. C. Card No. Mic 60-3815)

Alan Kellogg McAdams, Ph.D.  
Stanford University, 1960

The passage of the Labor-Management Reporting and Disclosure Act of 1959 offered an opportunity for a study which in many ways was unique, at least in the last decade. As an all out test of the political power of management versus labor it provided a gauge of these power relationships. To be measured accurately a situation must be known. The development of the Act was studied through interviews with participants and through analysis of public and private records. Seven chapters are devoted to a presentation of this information.

The evidence developed was analyzed in relation to a series of hypotheses dealing with the effects of organization and political relationships as determinants of political power. The conclusions are that the passage of the Act accurately reflected the power relationships in the American Society; that consensus on goals which preceded effective organization, and the relationships within the organizations themselves were important attributes of management political power; that the organization of the political groups supporting passage of the Act approximated "party government"; and that staff personnel had important influence on the content of the Act. The study utilized the concept of, and provided support for, the group approach to the American political process.

Microfilm \$4.75; Xerox \$16.65. 369 pages.

**WATER PROBLEMS IN  
SOUTHWESTERN ONTARIO**

(L. C. Card No. Mic 60-3126)

Herman Olaf Johan Overgaard, Ph.D.  
Columbia University, 1960

This dissertation was started in 1955 as a result of the author's study of the Report of the Select Committee On Conservation to the Ontario Legislature in 1950. This thesis notes the major factors which have led to Southwestern Ontario reaching the place it now holds in the economic structure of Canada, and indicates how a basic resource, water, is now retarding the growth of Southwestern Ontario. After describing the economic importance of water to man and his activities, the author outlines the physical geography of the Region as affecting the availability of water therein. It is then shown how the Region developed from an agricultural economy to an industrial economy, and how the continued growth and prosperity of the Region, particularly of the inland municipalities, is dependent upon abundant supplies of good quality water.

An attempt is made to show how inadequate the present local sources of water supply are for this purpose, following which a solution is proposed, namely, the construction of a grid system of trunk pipelines supplying water to the inland municipalities from the Great Lakes. How this solution can be implemented from a legal, administrative, and financial viewpoint is then discussed. Finally, a summary is made and recommendations are presented.

Microfilm \$3.95; Xerox \$13.95. 308 pages.

**AN ANALYSIS OF THE SHOE MANUFACTURING  
INDUSTRY WITH SPECIAL EMPHASIS ON  
CHANGES AND TRENDS IN THE USE  
OF VARIOUS DISTRIBUTION CHANNELS  
BY SHOE MANUFACTURERS**

(L. C. Card No. Mic 60-4785)

Boris Parl, Ph.D.  
Northwestern University, 1960

Adviser: Professor James R. Hawkinson

The purpose of this thesis is to study the changes in and the determinants of the distribution channels in the shoe industry.

Since the manufacturing characteristics and the nature of the consumer demand for the product greatly influence the patterns of the distribution channels, a relatively detailed analysis of production and demand aspects is included.

A study of the period 1630-1957 reveals significant changes in the distribution channels in the shoe industry. Direct distribution from producer to consumer prevailed until the end of the seventeenth century when the retail and wholesale middlemen appeared and assumed a growing role in shoe marketing. The shoe wholesaler reached a peak about 1875. From that time on, the relative importance of the shoe wholesaler declined almost continuously until 1948 when a possible reversal of the trend was suggested by Census data.



With the decline of the wholesaler, direct distribution from the manufacturer to the retailer became important. By the turn of the nineteenth century mass retailing in the form of department and chain stores and mail-order houses played a greater role, while the general and the apparel store in shoe retailing declined. From about 1937, the relative importance of shoe chains gradually declined, while the shares of department stores and mail-order houses in shoe distribution seem to have stabilized.

Direct sales from manufacturer to consumer through manufacturer owned retail chain stores originated in 1889. This vertical integration between the manufacturer and the retailer has been one of the peculiar marketing characteristics of the shoe industry along with a few other industries such as petroleum and apparel. A significant increase in vertical integration has occurred since 1950 through a number of acquisitions of retail chain stores by the leading shoe manufacturers. In addition, partial integration in the form of franchise stores, cooperative advertising, and dealer helps, has become an important means of influencing marketing channels by shoe manufacturers.

The changes in the marketing channel structure in the shoe industry are related to a number of variables. Among these, the important variables on the demand side appear to be: location and density of the market; seasonal and cyclical variations in consumer demand; changes in consumer requirements for variety, quality, and style; and consumer brand loyalty.

On the production side, the technology of production, specialization, geographic concentration of manufacturing plants, the number and size of the firms, advantages of scale, cost structure, and the degree of competition, stand out as the important determinants of the prevailing distribution channels.

Also, the structure of retailing institutions, the type and size of the stores, the degree of specialization in retailing by kind, type, and price line of shoes, and the state of communication and transportation facilities – all influence the choice of marketing channels used by the manufacturers. In addition, the efficiency and the practices of the existing and potential intermediaries along with the established tradition in the field, and the prevailing laws and social attitudes exert influence upon the use of marketing channels.

As a generalization, the use of distribution channels is governed by 1) the principle of economic distances, 2) the principle of similarity of assortments including quantity and time dimensions, and 3) the nature and degree of the prevailing competition.

On the basis of the observed trends, it appears that vertical integration will continue to gain in relative importance in the shoe industry. Similarly, the partial integration forms will tend to remain in extensive use by large shoe manufacturers. Increasing industry concentration and vigorous competition will probably lead toward further increase in the manufacturer influence and control exerted in marketing channels in various forms.

Microfilm \$8.45; Xerox \$30.15. 668 pages.

# AN ANALYSIS OF INDUSTRIES SEEKING RELIEF UNDER THE ESCAPE CLAUSE, THE NATIONAL INTEREST, AND THE IMPLICATIONS FOR UNITED STATES TRADE POLICY.

(L. C. Card No. Mic 60-3759)

Aaron Nathaniel Slotkin, Ph.D.  
New York University, 1960

Chairman: Professor Emil Lengyel

The industries that sought relief under the escape clause during the period studied (June 16, 1951 - July 31, 1954) are small. In terms of the size of their production force and the dollar value of their output, they play a very minor role in the American economy. With rare exceptions, they cannot compete abroad where they do not have the benefit of tariff protection. A considerable number of these industries enjoy substantial levels of protection. In many cases, the product on which an escape-clause application was filed was not the primary source of income for the domestic producers; in some instances, it was a minor item in total production and employment.

Domestic producers have adopted varied approaches to meet the challenge of import competition: cost reduction, market expansion, product diversification, and importing. Import competition presents an especially severe problem in areas where there are few alternative employment opportunities. Therefore, trade adjustment assistance should be part of a more comprehensive federal program for aiding depressed areas.

There is a basic difference in attitude toward foreign and domestic competition. We freely permit domestic producers using cheap labor (e.g., in Puerto Rico and the South) to capture markets from their regional competitors, but successful penetration of the United States market by imports from lower wage countries is usually ascribed to unfair competition.

Several controversial issues arose concerning the Tariff Commission's interpretation of the escape clause during the period considered: the significance of a decline in the domestic producers' share of the market, the scope of the domestic industry, the question whether imported and domestic articles were "like or directly competitive," and the choice of a representative base period for determining whether imports had increased. The judgment of individual commissioners on these issues depended largely on their trade policy orientation.

The premise that increased tariff protection will enhance national security is questionable. The Government's reversal of its position that the horological industry is vital to national security reflected the rapid changes in concepts of defense essentiality brought about by revolutionary innovations in modern warfare and the expansion of the nation's pool of precision skills. Opinion is widespread that the destructive power of nuclear weapons has made obsolete the mobilization base concept.

Because of our economic predominance and leadership of the free world, United States trade policy decisions have had a psychological impact that has far exceeded their economic effects. Tariff increases under the escape clause, particularly on watches and bicycles, have been sharply criticized abroad as contradictions of professed American policy to reduce trade barriers. The very existence of the

escape clause, it is asserted, discourages exports to this country because it creates uncertainty concerning the stability of United States tariff levels.

Dissatisfaction with the escape-clause procedure is inevitable because there is an inherent contradiction between the Congressional mandate that imports shall not be permitted to injure domestic industries and the discretion granted the President to implement it. The President, who must weigh the consequences of injury to a particular domestic industry against his over-all responsibilities for the national welfare, is likely to exercise his discretion to deny relief when these two interests conflict. Such situations arouse resentment in domestic producers who feel they have been denied relief for reasons outside the scope of the escape-clause investigation.

The administration of the escape clause would be clarified by granting the President statutory authority to disregard Tariff Commission findings for reasons of the national interest—as he now does in reality. Clarification is also required of a Presidential practice regarding supplementary escape-clause investigations that sets no time limit for reaching a final decision.

Microfilm \$4.85; Xerox \$17.10. 378 pages.

## ECONOMICS, FINANCE

### TAXATION OF INSURANCE COMPANIES IN OHIO

(L. C. Card No. Mic 60-4067)

Helen Arnold Cameron, Ph.D.  
The Ohio State University, 1960

Insurance, as a sharing or transfer of risk, developed early in the history of civilization.

Insurance followed two parallel and contrasting lines of evolution, one a communal sharing of risk, the other a commercial transfer of risk for an agreed-upon sum of money. Both types of insurance were present in the civilization surrounding the Mediterranean. Both, although dormant in the Middle Ages, reappeared early in the Renaissance. The communal form was found in the Guilds; the commercial form in the insurance loans of the Hansa and the Italian city states.

The first tax on insurance was a fee paid for the charter of incorporation of two English insurance companies in 1720.

The history of insurance from this time on is traced in the United States. Early taxation in this country followed the British pattern of fees charged for corporate charters.

The first provision for the annual taxation of insurance companies, outside of the property tax, was the New York law of 1825, which taxed the gross premiums of all insurance companies 10 per cent.

Various other devices for taxing insurance companies, such as dividend taxation, share taxation, and fees for agents' licenses, were attempted. However, the gross premiums tax emerged as the most adequate measure of property value of insurance companies.

Ohio's first tax on insurance companies was passed in 1830, and consisted of a tax on the dividends of foreign and domestic companies, with foreign companies taxed at a higher rate. By the 1840's, Ohio had accepted the gross premiums tax as a measure of property value. The Kelley Act and the Uniform Rule Provision of the 1851 Constitution suppressed this method of taxation.

As far as the foreign companies were concerned, this suppression lasted only until 1859. From this time on, Ohio has levied a 2½ per cent gross premiums tax on foreign insurance companies, while domestic companies are taxed on their capital stock at a moderate rate.

The mercantilistic attitude of the nineteenth century is still evidenced in the retaliatory legislation of Ohio, which provides that foreign insurance companies are to be taxed at the same rate, if their rate is higher than the Ohio rate of 2½ per cent, as that levied against Ohio companies in foreign states.

Gross premiums taxation is still the dominant form of insurance company taxation. Like other consumption taxes facing an inelastic demand, these are in the short run presumably shifted to the consumer and in the long run diffused throughout the economy.

The insurance industry, because of its economic power and fiscal capacity, possesses ability to pay. Through its extensive use of the judicial system, it qualifies under benefit theory.

The principal change that this dissertation advocates is uniform tax treatment of foreign and domestic insurance companies by Ohio and other states.

Microfilm \$4.45; Xerox \$15.75. 346 pages.

### CLASSICAL AND CONTEMPORARY THEORIES OF TAXATION: AN ANALYSIS OF THE AGGREGATIVE APPROACH TO TAX POLICIES IN THE TWO SCHOOLS.

(L. C. Card No. Mic 59-6304)

Sevim Görgün, Ph.D.  
Syracuse University, 1958

Supervisor: Jesse Burkhead

The Classical and Contemporary theories of taxation are both predominantly concerned with the employment, income, price and output effects of taxation under conditions of general equilibrium.

The four representatives of the Classical School who are discussed, Adam Smith, Jean Baptiste Say, David Ricardo, and John Stuart Mill, believe in an economic system governed by natural laws and in a minimum of outside interference in this system. Their tax policies are oriented toward preserving the natural order and toward promoting economic growth, the main economic objective of their time.

Smith introduces value judgements into the theoretical analysis of taxation by advocating a general tax levied according to ability, where ability is an arbitrary measure of benefits derived from state activities. Both Say and Ricardo basically accept the principles of taxation formulated by Smith. The latter accepts the existing order of production and distribution as inevitable and extends the



self-interest principle to the government sector. However, there is a great deal of divergence between the assumptions and the policy recommendations of these three economists. They argue for a direct tax proportional to income, on the assumption that the benefits enjoyed from state activity are proportional to income, but in their final conclusions recommend indirect consumption taxes, which are more or less regressively distributed. In their system taxes work against the welfare of the group by impinging on funds that will be used for capital formation. They resort to indirect taxes because these do not directly fall on savings. Because they are regressively distributed, they constitute less of a burden on the upper income groups, who perform an important function in the economy by saving and investing.

Mill states that laws of distribution are determined by social structure and gives a more discretionary aspect to tax policies by introducing the ability principle. However, the objectives of economic growth set narrow limits to policies for income redistribution. Mill vehemently criticizes progressive taxation, based on the ability principle and the decreasing marginal utility of income, and proposes to exempt savings from taxation.

Since the publication of the *General Theory* by J. M. Keynes, the fact that stability does not automatically occur in a capitalistic economy has come to be widely accepted, and it is generally believed that the government sector, which is not controlled by the market mechanism, has the power to correct any major deviations from the normal through adjustments in taxation and expenditures.

Tax policies for income and employment stabilization are formulated under the assumption that perfect competition exists in all markets and there are no rigidities in prices or factors. Taxes are classified according to their deflationary impact, depending on whether they are paid from the saving or from the consumption stream. Changes in taxes on consumption expenditures are considered more effective as stabilization measures because of their direct impact on effective demand. However, more emphasis is given to income taxes because yields follow changes in income more closely and therefore provide an inherent mechanism in the system which adjusts automatically to dampen the impact of cyclical fluctuations.

As a consequence of Keynesian economics the analysis of short run income, employment, and price effects of government taxation and expenditures have been fully incorporated into economic theory. However this does not solve the conflict between the different economic and social objectives pursued by taxation. Neither does it provide an answer to instability caused by structural factors, as in the case of monopolies. The major contribution of the Keynesian Revolution to tax theory has been a more realistic approach to the problems of a mature economy. Classical and Contemporary theories of taxation are concerned with differing types of economic systems.

Microfilm \$2.50; Xerox \$7.20. 154 pages.

## MONETARY ANALYSIS AND POLICY IN INDIA, 1948-59.

(L. C. Card No. Mic 60-3138)

Vinodchandra C. Shah, Ph.D.  
Columbia University, 1960

The purpose of this study is to analyse the scope, objectives and role of monetary policy in a mixed enterprise economy, and to evaluate the relevance to Indian conditions of the tools of monetary analysis and policy adopted or advocated in advanced countries. The study provides some evidence that in India the quantity-theory yields empirically better results than the income-expenditure theory. The correlation between money stock and income is better than that between autonomous expenditure and income. Hence, the tentative inference that the Reserve Bank of India should rely more on the quantity-theory than on the income-expenditure theory, both as a tool of monetary analysis and as a basis for formulating monetary policy. It should be stressed, however, that the Reserve Bank should conduct further research, testing these two theories by more refined models.

A further inference may be drawn, that in pursuing its objectives the Reserve Bank can concentrate on controlling the stock of money rather than on interest rates, for a dynamic and well-integrated financial organization is lacking and spending units do not hold large amounts of Government securities. The study casts doubt on the effectiveness of a rise in interest rates in appreciably reducing the pressure of aggregate demand in the short run, in view of fiscal policy and the nature of the industries left to the private sector. Therefore, in India money stock rather than interest rates should be regarded as the centre-piece of monetary action.

As regards tools of monetary policy, the thinness and lack of integration of the money and capital markets renders the Bills-Only policy inapplicable to Indian conditions and weakens the power of customary tools of central banking. The behaviour of the proximate causes influencing the stock of money also suggests that the Reserve Bank should rely more on other tools of monetary management, such as varying reserve requirements and selective credit controls.

It is found that an inconsistency between the objectives of monetary stability and economic growth arises because the Reserve Bank focuses its attention on the problem of increasing the elasticity of the supply of credit to the private industrial sector and tends to ignore the possibility that the operation of the acceleration principle may lead private investment to run ahead of the availability of physical resources at given prices. In the event of such inconsistency of objectives, the authorities should attempt to maintain reasonable domestic stability.

Economic planning, and a policy of deficit spending to promote economic growth, weaken the effectiveness of monetary policy. It is not proper for the authorities to expect fiscal policy to look after the problem of economic growth and monetary policy to take care of economic stability.

The scope of monetary policy in India is limited, on account of the structure of India's economy and financial organization. The Reserve Bank has little or no direct control over consumption demand and construction activity. The supply of credit for financing internal trade is not

completely within its purview. A growing proportion of total fixed investment is made by the Government and is thereby sheltered from the impact of monetary policy.

To make monetary policy effective in India, it is suggested that the Reserve Bank should control the stock of money by varying cash reserve requirements, by resorting to selective and direct credit controls and by preparing an annual credit plan. Further it should raise the level of interest rates and follow a flexible interest rate policy, in order to fund the public debt, to mobilize resources for the public sector and possibly to increase the flow of savings. The conclusion is that monetary policy can play a subordinate but still important role in achieving the country's economic objectives, provided fiscal policy is made more flexible. Microfilm \$6.90; Xerox \$24.55. 544 pages.

## ECONOMICS, HISTORY

### GOVERNMENTAL ECONOMIC PLANNING IN IRAN

(L. C. Card No. Mic 59-6300)

Mostafa M. Elm, Ph.D.  
Syracuse University, 1959

Supervisor: Sidney C. Sufrin

The purpose of this study is (1) to make a critical survey of Iran's Second Seven-Year Plan, its investment patterns and targets, (2) to study the resources and potentialities of Iran, and the current economic and institutional problems and (3) to suggest certain changes in the economic plan and the institutions so that the development of Iran may be expedited.

The paper first discussed Iran's efforts toward economic planning since 1925 to put the major theme of the study into historical perspective. It reviews the shaping and formulation of the First Seven-Year Plan, the varying views of Iranian planners and American consulting firms and their approaches in various areas of development. It then discusses the Second Seven-Year Plan, its main characteristics, sectoral allocations, sources of funds, methods of financing and finally the main achievements of the Plan.

The paper focuses on Iran's resources and potentialities to see how much land, labor, capital and mineral resources are available that can be utilized in any development plan. It then discusses the institutional problems in agriculture, government administration and social structure to see if any plan can fully succeed under the current social and institutional order. In the light of these studies the Second Plan is subjected to critical analysis while bringing in the theoretical concepts of economists concerning the objectives of a plan, the determination of investment patterns and the criteria for project allocation.

The major conclusions of this study are as follows:

1. Iran does not have a plan in a macro-economic sense and the Second Plan, as the first one, is merely a catalogue of public projects whose contributions to the national income, output, employment,

distribution of income, and balance of payments cannot be anticipated with any degree of certainty.

2. Any plan, no matter how refined it may be, cannot be successfully executed and would not maximize the welfare of the majority unless changes take place in certain institutions. Such changes should occur in agricultural institutions, the tax system, the government administration and the political orientation of the country.
3. The government should formulate a plan based on facts and figures with clear targets, applying certain criteria for the choice of its development programs and projects with full realization of their impact on national income, output, employment, consumption and the distribution of income. The geographical location and political situation of Iran necessitate measures that would increase income and employment in the short-run. However, some long-term agricultural projects should not be sacrificed. The present study shows that the plan should concentrate on the development of human resources, expand education, health, housing, roads, electricity, and develop water and agricultural resources. The development of industries should be left to the private sector and should come with the natural impetus of the improvement of general economic conditions.
4. The success of the plan does not only require proper planning and programming with an eye toward the complex problems of an economic and social nature that arise in the process of development but also proper organization and administration, suitable institutional devices for the diffusion of wealth and power, law and order, social justice, financial integrity, political stability, the gradual spread of education and the development of self-reliant, skilled, and responsible citizens with dedication, willing to work together and to participate in the reconstruction of Iran.

Microfilm \$4.70; Xerox \$16.65. 366 pages.

## ECONOMICS, THEORY

### A COMPARISON OF THE THEORIES OF ENTREPRENEURIAL EXPECTATIONS OF KEYNES AND SCHUMPETER

(L. C. Card No. Mic 60-3230)

Ronan Gerald Macdonald, Ph.D.  
The University of Wisconsin, 1960

Supervisor: Professor James S. Earley

One of the contributions of Keynes' General Theory was his insistence on the importance of expectations as an element of instability in business fluctuations. In his economic model, decisions to expand plant are based upon long-term expectations, and the state of these expectations enters as an integral element of his aggregative system.



Earlier views on expectations had been dominated by the classical emphasis on long-run equilibrium tendencies, and by the classical custom of analyzing problems of capital and interest in real terms. Consequently, the problem of expectations was left largely to the writers on money and finance, such as Tooke, Overstone and Henry Thornton, and was incorporated into their monetary and business-cycle analysis. This procedure was also adopted by Marshall, Mill and Pigou, who were inclined to regard the business cycle as being merely a temporary deviation, caused by monetary disturbances, errors, and shifts in business confidence, from an immanent full-employment general equilibrium position.

Keynes rejected this view on the ground that, in a changing economy, the existing data were insufficient to formulate a unique mathematical expectation. Because of this fact (and the businessman's consciousness of it) expectations for the remote future are held with little confidence, and are subject to violent fluctuations. Since the level of employment and income is determined largely by the rate of investment, there is no justification for expecting persistent full-employment conditions. Keynes thus rejected Marshall's view that the economy grew smoothly and continuously, approximating full-employment conditions; he also rejected Marshall's monetary explanation of the cycle, and Pigou's view that uncertainty could be analyzed as a probability distribution.

Schumpeter, in his pre-Keynesian writing, also rejected the classical view of expectations, but rather on the ground that it would be appropriate only in a strictly stationary system. In his analysis uncertainty develops in consequence of a departure from routine methods of doing business, and, in the modern capitalist economy, the most important cause of disruption of routines is the innovation.

In the absence of innovation, expectations are little more than applications of a learned routine which has been validated by repeated test and is held with confidence. The innovation destroys the routine and induces uncertainty and errors of optimism and pessimism, and businessmen are forced to adapt by learning new routines. The result is a discontinuous shift toward a new general equilibrium system, and this process of adaptation, in Schumpeter's view, constitutes the essential element of the business-cycle process.

Schumpeter's analysis anticipates Keynes' treatment in most respects. His treatment of uncertainty as an important element of the business cycle had its origins as early as 1910. His analysis of expectations in terms of business routines is almost equivalent to Keynes' concept of the "conventional judgment," although Keynes restricts his analysis to the subjective level. Considered as a general theory of expectations, apart from its particular application in his *General Theory*, Keynes' analysis contains no element not already treated by Schumpeter.

To some degree, the respective theories complement each other. Keynes' version is best suited to extremely short-run situations, while Schumpeter's is tailored to the typical business cycle. Keynes emphasizes the role of subjective elements, speculation, and financial leadership, and Schumpeter the interactions of the objective factors of change and the industrial decision-making process.

The two writers seem to differ in regard to the influence of "change." Keynes' analysis is consistent with the view implicit in Marshall, that innovation has only a random impact on economic development. For Schumpeter, change is not random but concentrated at business-cycle revivals, and constitutes the fundamental agent of the business cycle. Microfilm \$3.30; Xerox \$11.50. 253 pages.

## EDUCATION

### EDUCATION, GENERAL

#### THE EFFECT OF INCREASED SCHOOL ENROLLMENTS ON SCHOOL COSTS IN CONNECTICUT

(L. C. Card No. Mic 60-5210)

Thomas Patrick Curtin, Ph.D.  
The University of Connecticut, 1960

**The Problem.** School enrollments have been increasing steadily in most Connecticut towns. This study is designed to determine what effect these increasing enrollments will have on school costs in school year, 1969-70.

**The Method.** Assuming that conditions will continue to 1970 as they have operated during the past five years the average annual change for those past years is used as a factor for making predictions for school year, 1969-70.

**The Conclusions.** The enrollments in the public schools of Connecticut will increase 41.6 per cent in the next decade,

rising from a total of 444,834 pupils in 1958-9 to 629,720 pupils in 1969-70.

Costs for current school operations will increase from \$163,048,371 at present to \$375,189,178 in 1969-70, an increase of 130.1 per cent.

The state will pay \$16,000,000 more in grants for current operations in 1969-70 than the present payment of \$40,000,000.

Over \$300,000,000 in school building projects were completed between 1946 and the end of 1959. During the next decade approximately \$345,000,000 in school buildings must be provided for the increased school enrollments.

The state grants for building purposes will more than double in the next ten years. At present the state pays about \$4,800,000 annually in building grants. This amount will be increased by an additional \$5,500,000 by 1970.

Not only will the costs of education increase but also the costs of other governmental services. The cost of such services will rise from \$116,250,000 in 1959 to about \$317,350,000 in 1970, an increase of 77.6 per cent.

The total tax burden of the towns of Connecticut will

more than double in the next ten years. This burden will increase from about \$300,000,000 to over \$650,000,000.

The total of state grant payments will increase to about \$66,500,000 in 1970, an increase of \$22,000,000 or 50.0 per cent.

It is expected that the net grand lists of the towns will increase from about \$8,160,000,000 to an amount over \$11,240,000,000 in the next decade.

Tax bills will more than double in 30.0 per cent of the towns and will triple in about 4.0 per cent.

Microfilm \$2.55; Xerox \$8.80. 195 pages.

#### A STUDY OF THE DEVELOPMENT AND USE OF LEISURE TIME WITH IMPLICATIONS FOR EDUCATION

(L. C. Card No. Mic 60-3768)

Thomas Joseph Desmond, Ed.D.  
New York University, 1960

Chairman: Professor Miltor A. Gabrielsen

The purpose of this investigation was to analyze the factors which have contributed to man's acquisition and use of leisure, with a view toward drawing implications for education. The study, beginning with the early post-Civil War years, was extensive rather than intensive and limited to the United States. With reference to education the study was concerned only with grades seven through twelve in the public schools.

The procedures for accomplishing this purpose involved (1) a study of the manner in which the growth and frequency of leisure was effected by the evolving changes in the scientific, technological, and industrial pattern and by social invention; (2) the identification of the factors which have effected man's use of leisure and the ways in which such factors have influenced his choice of activities; (3) determination of the extent to which education has met the challenge of leisure; and (4) the formulation of principles which should serve to guide education in preparing students for the worthy use of leisure.

The study involved intensive library research, initially, for the purpose of orientation, and later for the investigation proper. It was also deemed necessary to consult authorities in the fields of education, recreation, sociology, and psychology to determine first, the merit of the study, and second, to seek guidance in establishing a framework within which the problem might be designed. Also involved were several visits to departments and agencies of the federal government in Washington, D. C. The purpose of these visits was to locate and identify governmental documents containing data pertinent to the study.

The social order of the United States at mid-twentieth century, and that of 1870 are worlds apart. The transition from a predominately rural society to a highly complex industrial nation instigated sweeping social and economic changes in American life. Technological developments emerging from gains in scientific knowledge, plus American ingenuity, revolutionized methods of transportation, communications, mechanical power production, agriculture, mining, and manufacturing; progressively reduced the hours of work and increased the hours of leisure; brought

about the urbanization of America; uprooted traditions and mode of living; and created new problems and opportunities for education and recreation.

Although the development and trend of leisure has been influenced chiefly by advances in science, technology, and industry, social invention has also played an important part in the process. Prominent among the social inventions which have effected the growth, frequency, and use of leisure are the labor movement, holidays, vacations, retirement systems, education, and recreation.

While preparation for the worthy use of leisure has long been acknowledge as one of the principal objectives of education, efforts to achieve this objective have been inadequate. Education has been slow to implement this objective with a plan of action. Avocational and leisure pursuits are not acquired any more spontaneously than are the knowledges and skills for vocational careers. The skills, interests, and attitudes required for the worthy use of leisure must be learned.

Emerging developments offer promise of more effective education for leisure in the future. Recent developments, which are receiving favorable response from school administrators, include school camping and outdoor education, a new recognition of the significance of leisure and recreation, and the concept of the community school as an educational-recreational center.

Conclusions drawn indicate that (1) the trend in the direction of a decline in the average annual hours of work and a corresponding increase in leisure may be expected to continue; and (2) education's response to the challenge of leisure has been inadequate.

Microfilm \$6.75; Xerox \$23.85. 530 pages.

#### THE EFFECTIVENESS OF OPEN-ENDED CHEMISTRY EXPERIMENTS IN A HIGH SCHOOL SETTING: A COMPARISON OF OPEN-ENDED CHEMISTRY EXPERIMENTS WITH THE CONVENTIONAL LABORATORY EXERCISES IN TEACHING SELECTED HIGH SCHOOL CHEMISTRY CLASSES.

(L. C. Card No. Mic 60-3750)

Irmgard Frieda Karle, Ph.D.  
New York University, 1960

Supervisor: Professor J. Darrell Barnard

This investigation sought to compare the relative effectiveness of open-ended laboratory experiments with the conventional laboratory exercise in selected high school chemistry classes. The investigator compared the effectiveness of these two types of experiences in laboratory work with regard to the specific outcomes of critical thinking, interest in science, and the recall of information, application of principles and the quantitative application of principles.

The population for this experiment was composed of ninety girls at Hunter College High School who chose to elect chemistry in the tenth and eleventh grade. There were both experimental and control groups in each of these two grade levels. Consequently, four classes were involved; both the tenth and eleventh grade experimental



classes contained twenty-four students each; both tenth and eleventh grade control sections contained twenty-one students each.

The chemistry classes met for six forty minute periods per week. Four of these periods were devoted to class work and two consecutive periods were utilized for laboratory work.

The investigator taught all four classes in the class work and in the laboratory work. The class work was identical in all four experimental and control sections; the laboratory work, however, was quite different. The experimental sections used the open-ended experiments sponsored by the Manufacturing Chemists' Association for their total laboratory experience. The control group performed exercises found in the manual Laboratory Experiments in Chemistry by Brownlee, Fuller and Whitsit.

The students in the control groups recorded their observations in the laboratory manuals and answered the questions posed in each exercise. In the experimental groups the students handed in a written report in which were incorporated a statement of the problem undertaken, the observations made, and the conclusions drawn.

The STEP Science Test, Level 2, Form 2A, used to measure critical thinking, was administered in September, 1958, to all four classes. During May, 1959, the STEP Science Test, Level 2, Form 2B, was administered. The investigator analyzed the data by means of covariance selecting the five per cent level of confidence for acceptance or rejection of the null hypothesis.

The Kuder Vocational Preference Record-Form Ch was used as a measure of the students' interest in science. The instrument was administered in September, 1958, and again in May, 1959. The data was analyzed by means of covariance.

The instruments used for objective evaluation of achievement in high school chemistry was the ACS-NSTA Cooperative Examination in High School Chemistry, Form 1959. This instrument was administered in May, 1959, and the data thus obtained was used as the Y variable in the analysis of covariance. The X variable in this instance was the score achieved on the Lorge-Thorndike Intelligence Test.

The analysis of data indicated that there was no significant difference in these two methods of laboratory work with respect to critical thinking. It was also found that there was no significant difference in these two methods of laboratory work with respect to interest in science. The analysis of data indicated that for the recall of information, the application of principles, and the quantitative application of principles, there was no significant difference in these two methods of laboratory work.

The investigator further analyzed the data by equating the groups after the experiment had been completed and used the analysis of variance with thirty pairs of students. When working with equated groups, it was found that there were no significant differences in these two methods of laboratory work with respect to critical thinking, the development of interest in science, and in the recall of information, the application of principles and the quantitative application of principles.

Microfilm \$2.50; Xerox \$8.00. 171 pages.

## THE PREDICTION OF COLLEGE SUCCESS FROM A BATTERY OF TESTS AND FROM HIGH SCHOOL ACHIEVEMENT

(L. C. Card No. Mic 60-4634)

John Marshall Long, Ed.D.

University of Virginia, 1960

### I. PROBLEM

This study was planned to give the College of William and Mary in Norfolk factual information on how well presently available test data and other information obtained routinely from each applicant can be used to forecast future success in college. The problem was to make an optimum prediction of college success, for a given sample of freshmen, from a battery of tests and other variables.

### II. PROCEDURE

Multiple regression analysis techniques were used. Multiple regression coefficients, multiple regression equations, and analysis of variance data for testing the regressions were calculated by automatic computing equipment.

### III. CONCLUSIONS AND RECOMMENDATIONS

Conclusions. Results indicate that the best individual predictor in the study is high school grades ( $r = .60$ ). For a reasonably good substitute, the Cooperative School and College Ability Test score ( $r = .47$ ) or the Usage score of the English Training test ( $r = .49$ ) are also good individual predictors.

The best combination of two scores would be high school quality point average and the verbal score of the Cooperative School and College Ability Test which gives an  $R_{Y(X_1, X_2)}$  of .66. A good combination of five scores would be high school quality point average, the verbal score of the Cooperative School and College Ability Test, Impulsive-Restraint Index score of the Guilford-Zimmerman Survey, the Usage score of the English Training test, and the total score of the Cooperative School and College Ability Test. This combination gives an  $R_{Y(X_1, X_2, X_{23}, X_{11}, X_4)} = .68$ --very close to .71.

Insofar as selection is concerned, the personality survey and interest index as a whole do not seem to be highly effective. Such tests are very valuable and interesting in a multiple regression analysis, however. As has been shown, an exception is the Impulsive-Restraint Index of the Guilford-Zimmerman Survey. The contribution this index makes to prediction seems to single out and emphasize that a serious-minded, deliberate, persistent effort (i.e., self-control) as opposed to a happy-go-lucky, impulsive, carefree attitude is quite important in attaining good grades.

Recommendations. In addition to these statistical findings, the study seems to justify certain general recommendations for college entrance policy. These are listed in rough order of importance.

It would seem that in selection, more significance should be given to the high school grades of applicants to the College. The study reaffirms the conclusion, often found, that good grades in high school are the best single indicator of good grades in college.

For selection purposes, the use of the Cooperative School and College Ability Test and the Usage part of the

English Training test seem to be amply justified as the scores on these tests are reasonably good predictors of college quality point average. Perhaps the use of a combination of the academic predictors, along with a major emphasis on high school grades, would be most practical for the College to use.

By way of a final summary, the one main conclusion of the study is:

The high school quality point average is highly predictive of college quality point average, but other variables--mostly academic but also including certain personality characteristics--serve to improve somewhat the prediction of college success.

Microfilm \$2.50; Xerox \$3.80. 67 pages.

THE HUMANITIES IN COLUMBIA COLLEGE  
1900-1960: AN ANALYSIS OF TRENDS IN  
HUMANISTIC STUDIES IN THE UNDERGRADUATE  
CURRICULUM OF COLUMBIA COLLEGE.

(L. C. Card No. Mic 60-3752)

John MacEachen, Ph.D.  
New York University, 1960

Supervisor: Professor Alonzo F. Myers

The purpose of the study was to examine the relative status of the humanities in the undergraduate studies at Columbia College, New York City, from 1900 to 1960, and to analyze the influences that have affected their character and have determined the emphasis assigned to them in the curriculum. As historical background for the main purpose of the study, an analysis of the classical studies in Columbia College from 1754, the year of its foundation, to 1900 was completed.

Several questions gave direction to the inquiry. Does the concern of educators about the status of the humanities have a basis in fact? Is this apprehension symptomatic only a readjustment in the collegiate curriculum, implying changes in content and means through which humane learning is pursued? Has the reduced study of the ancient languages meant a comparable reduction in the knowledge of the ancient literatures? These questions applied to Columbia College were pertinent to the research.

The principal means of investigation was the historical method, employed at first in the examination of previous research and knowledge related to the problem. The evaluation of primary sources was guided by the criteria of external and internal criticism. Consequently the materials were subjected to positive and negative analysis, which concern the textual interpretation of statements and the validity of statements respectively.

Critics in the eighteenth and nineteenth centuries questioned the study of the classical languages and literatures as the *sine qua non* of the collegiate curriculum. However the classical course remained firm at least until the middle of the nineteenth century.

In the second term of 1869-1870, the Columbia College seniors were granted the option of substituting physics and calculus for Greek and Latin respectively, technology for philosophy. By 1880-1881 Greek and Latin disappeared as requisites from the junior year, to be restored in

1885-1886. Beginning in 1893-1894 the sophomores could substitute chemistry for Greek or Latin. The ancient languages were no longer required in the junior year. By 1897-1898 Greek or Latin was required only in the freshman year. Beginning in 1916-1917 Latin or Greek was no longer prescribed for the degree of Bachelor of Arts.

The College had begun to construct a corpus of knowledge that would fill the function in the new system of learning that the classical studies had reputedly done in the old curriculum. This knowledge was to become the common property of all students, generating intellectual, moral, and social unity.

By 1919 the course Contemporary Civilization was established as an interdisciplinary program. In the same year John Erskine proposed that all the students be required to read the masters of literature and philosophy in English versions. His proposal was modified and took form in General Honors (1920-1929) and in Colloquium on Important Books in 1932, both courses for selected juniors and seniors.

By 1937-1938 Humanities A and B, employing materials from literature and philosophy, the arts, and music, were introduced as a two-year sequence required of the freshmen and sophomores. In 1946-1947 Humanities 3-4, composed of readings in European and American literature and philosophy of the nineteenth and twentieth centuries, became a sequel to Humanities A, which included the European classics of Ancient Greek times through the eighteenth century. The colloquium in Oriental Humanities was first offered in 1948-1949, a reading and discussion course devoted to the master writings of several oriental traditions.

Accordingly the humanities maintain a firm position at Columbia College in the presence of the vast increase and material importance of scientific knowledge.

Microfilm \$2.90; Xerox \$10.15. 222 pages.

AN EVALUATION OF THE ROAD TEST  
PHASE OF THE DRIVER LICENSING  
EXAMINATIONS OF THE VARIOUS STATES:  
AN INVESTIGATION OF CURRENT ROAD  
TESTS AND TESTING PROCEDURES, AND  
THE DEVELOPMENT OF A VALID AND  
RELIABLE ROAD TEST BASED ON  
DERIVED IMPLICATIONS.

(L. C. Card No. Mic 60-3751)

Francis Stanley McGlade, Ph.D.  
New York University, 1960

This research was undertaken to develop a valid and reliable road test which would be practical in application by driver licensing agencies and driver educators.

The road test of driving performance is one of the most important screening devices in licensing drivers. In the majority of licensing districts, once a person has obtained a driver's license, he keeps it for the rest of his life without subsequent or periodic re-examination. This fact necessitates the use of a valid road test so administered as to give it an adequate measure of reliability. There is no scientific evidence, in terms of validity and reliability, to substantiate the use of the road tests currently employed by the licensing agencies.



The first road test rating scales were devised by driver educators to test the driving ability of students in driver education classes. Others were developed for training purposes in the transportation industry. These rating scales, or score sheets, were very elaborate and complex. The major weakness was that the observer had to spend more time and concentration in filling out the score sheet than in observation of the driver's performance.

Thus far, the most difficult problem in establishing road test validity has been that of determining a sound criterion or criteria of validity. The most commonly mentioned criterion, that of accident and violations records, is not a valid one, since these records are lacking in validity.

In this study, the hypotheses established as criteria for road test validity were: (1) that licensed drivers who had completed a high school course in practice driving instruction would score significantly better on a valid road test than drivers who had not had such instruction; and (2) that experienced drivers would score significantly better than relatively inexperienced drivers who, in turn, would score better than chronic violators and accident repeaters.

An experimental road test was developed as follows:

1. Formulation of a rating scale based on information gathered from forty-six licensing agencies concerning the use of road test items and administrative factors relating to the road test.
2. Submission of the rating scale to a "jury of experts" composed of driver licensing authorities and driver educators.
3. Selection of road test items and their weight values from the results of the ratings.
4. Development of precise road test item descriptions and scoring charts from driver license examiners' manuals.

The experimental road test was administered by three license examiners and one driver education instructor to a total of one hundred and twenty-nine subjects, broken down as follows: (1) thirty-one with practice driving instruction; (2) thirty without such instruction; (3) twenty-five experienced drivers; (4) twenty-five relatively inexperienced drivers; and (5) eighteen accident repeaters and chronic violators. The first two groups were controlled for age, sex, grade in school, mileage driven, and accident and moving violations records. The third and fourth groups were controlled for age and accident and moving violations records.

Application of the experimental road test resulted in the following findings:

1. The subjects with practice driving instruction scored better than those who did not, significant at the .0001 per cent level.
2. The experienced drivers scored better than the inexperienced drivers, significant at the 1 per cent level. The experienced drivers scored better than the violator group, also significant at the 1 per cent level.
3. The inexperienced drivers scored slightly better than the violator group, but the difference was not significant.
4. The road test demonstrated a reliability, by the test-retest method, of .77, significant at the 1 per cent level.
5. The road test demonstrated inter-examiner reliabilities, by simultaneous testing, of .93 and .88, both significant at the 1 per cent level.
6. The median time for administering the road test

was sixteen minutes, one minute more than the median time recommended by the licensing agencies.

On the basis of these findings, it appears that the road test provides a high degree of uniformity and reliability, that it is practical in application, and that it may be used successfully to test driving performance of license applicants and driver education students. It is recommended that the road test be adopted by licensing agencies and driver educators.

Microfilm \$3.55; Xerox \$12.60. 276 pages.

#### A STUDY OF THE STUDENT ACTIVITY PROGRAM AT NEWARK STATE COLLEGE

(L. C. Card No. Mic 60-3773)

Vera F. Minkin, Ed.D.  
New York University, 1960

Chairman: Professor Alonzo F. Myers

A study was made of the student activity program at Newark State College to discover the extent to which it meets with student approval and the extent to which it satisfies the social interests and needs of the student body with a view toward making such changes as might be indicated.

The instruments used in collecting the data were: General Information Sheet showing the year of graduation, curriculum, sex and marital status of each student; the kind and degree of on and off-campus activities.

Student Evaluation of Student Activities form, an adapted form of Kamm and Wrenn's "Evaluation Report Form" to give students an opportunity to evaluate the institution's degree of success in providing an adequate program of activities in the following categories: student government, social organizations, publications, athletics, music, dramatics, religious and social service, departmental or special interests, honoraries, political organizations, class activities.

Inventory of Personal-Social Relationships to determine the activities and interests of students in the following categories: family, faculty, opposite sex, belonging, social skills, intellectual and aesthetic, social service, leadership and initiative.

The questionnaire was answered voluntarily by 460 students, 68 per cent of all those in the general elementary, kindergarten-primary and junior high curricula in attendance in the Spring of 1957.

Among the students responding, a greater percentage of women than men participated in the various activities. Choice of curricula did not appear to be a factor in degree of participation. There was no activity in which as many as two-fifths of the entire student body participated. Those in which approximately one-fifth of the total group participated were: departmental or special interest groups, religious, class activities, women in honorary society; fewer than one-fifth were active in student government or athletics; one-tenth or fewer on publications or in dramatics.

Degree of participation does not coincide with approval of the activity. Dissatisfaction was expressed with only two types of activities: political organizations and departmental or special interest clubs. Almost half were satisfied with social and religious organizations; more

than half were content with music, publications, student government, dramatics, class activities; upper classmen were satisfied with the honor society.

According to the objective criteria by which the program was evaluated, it was found the conventionally accepted activities were provided, students know they exist, some students participate, the majority approve. There is evidence of relatively little student growth in social responsibility or adjustment, additional participants are not developed, there is little provision for developing skills in democratic processes, there is practically no opportunity provided for students to share in the development of administrative and academic policies and programs.

The women students are close to their families, seeming to have done little breaking away. Students seem to develop closer relationships with faculty as they remain in college, desiring to see them as co-workers and friends outside of class. There is a great deal of "normal" heterosexual activity among the students, a gregarious group with a strong unity of interests and activities. They enjoy being part of a group, but are not interested nor do they participate in activities requiring skills, leadership ability or initiative. There is strong interest in social service activities.

It is suggested that a few all-college committees be established in fields of general interest and concern to students and faculty to work toward common goals for the purpose of helping students learn how to work in situations in which they demonstrated weaknesses and insecurity.

Freshmen orientation classes should be broadened for purposes of indoctrination, self-adjustment, preparation for intelligent participation in group projects.

Microfilm \$3.50; Xerox \$12.40. 272 pages.

#### A COMPARATIVE STUDY OF PROGRAMS, FACILITIES, AND STAFF OF SECONDARY SCHOOL SCIENCE DEPARTMENTS IN VIRGINIA.

(L. C. Card No. Mic 60-4635)

David Doggett Redfield, Ed.D.  
University of Virginia, 1960

The purpose of this dissertation was to make a comparative analysis of factors relating to the programs, facilities, and staff of both white public and independent science departments of Virginia secondary schools. Three major approaches were utilized in determining the scope and content of the study. First the related literature was examined. Next a special advisory committee of University of Virginia scientists and educators made specific recommendations for inclusion in the study. Last an analysis was made of available data concerning Virginia science teachers who attended the University of Virginia National Science Foundation Academic Year Institute during the academic years 1957-58 and 1958-1959. Based on these resources guide lists of questions for investigation were formulated.

A sampling design was prepared utilizing a stratified random sample for the Virginia white public secondary schools. This sample consisted of seven geographical strata from which four schools were selected randomly to represent each stratum. Twenty-seven of these twenty-

eight public schools participated. Also every non-Catholic independent accredited secondary school which had been in operation for two or more years participated in the study. To the extent that no significant differences were found between the public school sample and the State of Virginia 1958 distributions of school size, number of science courses offered, and rural-city grouping, the public school sample was validated.

All of the participating fifty-seven schools were visited for approximately three hours each. In this time interviews were held with both the school administration and the senior science teachers. The laboratory and library facilities were also inspected. Specific information was sought concerning:

1. the science offerings and enrollments of the schools,
2. science requirements for graduation,
3. anticipated directions of curriculum growth,
4. programs for the gifted,
5. guidance and testing services,
6. science staff turnover, salaries, and benefits,
7. personal and professional backgrounds of senior science teachers,
8. adequacy and availability of science facilities,
9. care and use of science equipment,
10. adequacy of storage facility for science equipment,
11. utilization of industrial, community, and government resources,
12. adequacy of library facilities for science education,
13. library availability and use, and
14. science materials carried by the libraries.

In each of the foregoing areas, comparative information was presented as derived from the field investigation. In the case of the public schools, no quantitative inferences were drawn concerning the population. Rather the data were presented as suggestive of what one might expect to find when conducting a similar study involving a much larger sample. Both within and between groups, considerable differences existed with regard to philosophy, purposes, and programs.

It was not the intent of this study to conclude with any sweeping generalizations as to whether the public or independent schools were found to be better. Within the framework of the wide diversity of findings reported, each had relative strengths and weaknesses. Findings have been presented concerning many and varied factors relating to the numerous science programs of the fifty-seven participating schools that they may serve as a useful reference for any Virginia school, public or private.

Microfilm \$2.50; Xerox \$6.00. 125 pages.



AN APPRAISAL OF GUIDANCE SERVICES  
OF THE NEWARK SECONDARY SCHOOLS  
THROUGH A FOLLOW-UP STUDY OF  
SELECTED SCHOOL LEAVERS

(L. C. Card No. Mic 60-3777)

William Albert Rubinfeld, Ed.D.  
New York University, 1960

Chairman: Professor Robert Hoppock

The Problem

The purpose of this study was to appraise Newark, New Jersey secondary school guidance services through a follow-up study and to make recommendations for improving the program on the basis of respondents' reaction and suggestions.

The Procedure

Printed questionnaires were mailed to the subjects, who entered the ninth grade in September, 1951, and remained in school at least one year. There were three mailings to the 1,881 subjects, in February, March, and May, 1959. Questionnaires reached 1,502 students. Returns totaled 808, of whom 693 (64.6%) were graduates and 115 (26.8%) were drop-outs.

The Results and Conclusions

Occupations course: Diversified ratings made it difficult to secure a definitive description of the appraisal of the course. (More were unfavorably disposed.) Despite this, retention of the course was strongly supported, with only 6.1 per cent of both graduates and drop-outs recommending that it be dropped. A required course was advocated by eighty per cent of both groups. Reinforcing this recommendation were 300 written comments. The graduates had divided feelings about moving the course from the ninth to an upper grade; the drop-outs strongly favored retention in the ninth year. Both groups voted significantly for greater emphasis on occupations and personal-social relations. Recommendations for improving the course included field trips, visits to schools and places of employment, and use of guest speakers. The necessity for having the course taught by properly qualified, competent, and interested teachers was noted.

Career day, vocational, and school and college conferences: There were slight differences in recollection of topics covered, with career day having the lowest percentage. The retention, more frequent offering, and publicizing of all these services were overwhelmingly advocated. Suggestions were indicative of a preference for periodic vocational conferences rather than career days.

Military information program: Graduates, noting the patent deficiency in the type and caliber of services, urged strengthening the program. Ratings of available programs were significantly poor. Topics recommended for an expanded program emphasized schooling opportunities, description of enlistment programs, career opportunities, and a detailed picture of the six months' program. Securing information from disinterested sources, preferably qualified alumni, was suggested.

School orientation programs: Except for an item on the use of radio programs, orientation services were over-

whelmingly approved. Assemblies in receiving schools and talks by counselors to feeding schools were the favored programs. Suggestions for improvement emphasized giving older students orientation responsibilities; other ideas included more school visitation, classroom visits, and increased pre-orientation counseling.

Over-all reactions to guidance services: Rank order placement of services for graduates, based on a comparison of weighted scores, follows: assistance in subject selection, interviews with grade advisors, help from the head counselor, placement services, assistance from subject teachers, group conferences on guidance problems, school and college conferences, career day, vocational conferences, assistance from homeroom teachers, orientation programs, testing programs, occupations course, help from administration, and finally, military information programs. Drop-outs' appraisals were similar, with the exception of their higher placement of conferences on guidance problems.

Need for guidance help: A present need for guidance assistance was expressed by the respondents; this need was expressed most frequently by drop-outs, the unemployed, and males.

Suggested Applications

The study concluded with specific recommendations for improvement in the program. Program changes for appraised services were developed, with practically all respondents' suggestions being embodied in the recommendations.

Microfilm \$2.55; Xerox \$9.00. 196 pages.

EDUCATION, ADMINISTRATION

THE ORGANIZATION AND ADMINISTRATION  
OF THE INSTRUCTIONAL MATERIALS  
CENTER IN MEDIUM-SIZED  
SCHOOL DISTRICTS

(L. C. Card No. Mic 60-3783)

Virginia Cooper Barnes, Ed.D.  
Stanford University, 1960

STATEMENT OF THE PROBLEM. This study explored administrative principles and operational procedures in an effort to identify guide lines for the effective, efficient, and economical operation of instructional materials centers in medium-sized school districts (5,000 to 10,000 ADA).

PROCEDURE. This study was designed to obtain insights and develop hypotheses for future investigation, rather than to obtain statistics of center operations. Therefore, an exploratory study framework was used. Data were collected in interviews with twenty selected specialists working in California in the field of instructional materials. Before the interviews were conducted the generally accepted goals of the center were defined in the form of a set of criteria for appraising successful or useful operations and the major problem areas were identified. The identified

problems were presented in two interview guides: one for interviewing personnel who administer centers; and one for teachers and principals who use them.

The data were collected through tape-recorded informal interviews in large, medium, and small districts, to insure inclusion of a breadth of experience and identification of operations that would be useful to medium-sized districts. Administrators as well as non-certificated employees were interviewed in all districts, and principals and teachers who use the center were interviewed in medium-sized districts.

The data were analyzed in terms of the six operational functions and the sixteen categories of materials and services usually provided by the center. The data are presented in terms of tentative hypotheses and described in terms of what should be done to have the center operate effectively. All operations or procedures that were found to be acceptable in terms of the criteria were included in the final report.

**FINDINGS.** The findings are reported in six chapters based on the operational functions of the center as they relate to the sixteen categories of materials and services.

The first chapter of the report includes the operations related to the acquisition of materials. It discusses the organization of commercial materials needed to locate items for purchase. It describes the procedures for previewing materials, locating sources, procuring, receiving and routing, evaluating, and returning them. The chapter also discusses budgeting and purchasing procedures.

The second chapter investigates the procedures involved in organizing the materials within the center, including development of inventory or permanent record cards, processing materials, and arrangement of materials on the shelves and appropriate shelving facilities.

The third chapter discusses procedures and operations involved in informing the district staff of materials and services provided by the center as well as circulation procedures used in securing and returning materials. It also discusses the strengths and weaknesses of the card and printed catalogs, as well as inexpensive methods of reproducing the printed catalog. A final section includes suggestions for preparing a summary of center operations in the form of the circulation report.

The fourth, fifth, and final chapters include: discussions of inventory operations and procedures, maintenance and repair services, and an analysis of the responsibilities of professional and non-certificated personnel as they relate to the fulfillment of the goals of the center.

**RECOMMENDATIONS.** The study identifies five areas in need of further investigation: (1) appropriate use of available materials, (2) plans for instructional materials center facilities, (3) the relationship between school building, district, county, and state centers, (4) an evaluation of the hypotheses brought forth in this paper, and (5) a study of the applicability of these hypotheses to centers in larger or smaller districts.

Microfilm \$3.20; Xerox \$11.25. 247 pages.

# A STUDY OF THE PREPARATION PROGRAMS FOR EDUCATIONAL ADMINISTRATORS AT THE EIGHT CPEA CENTERS

(L. C. Card No. Mic 60-4065)

Leonard Arden Brubaker, Ph.D.  
The Ohio State University, 1960

This study was designed to examine the preparation programs for educational administrators at the eight universities that received the original grants of money from the W. K. Kellogg Foundation, under the program which was known as the Cooperative Program in Educational Administration, or simply "CPEA."

The purposes of the study were (1) to determine the present character of preparation programs for educational administrators at the eight original CPEA Centers and certain affiliated institutions; (2) to ascertain the design for the preparation programs for educational administrators as developed by these universities; (3) to discover the major changes that have occurred in the preparation programs for educational administrators during the CPEA years; and (4) to determine the direction of future development of these preparation programs.

The data for the study were collected by means of an inventory, which was based on the writer's construct of the preparation program for educational administrators, and rated by a jury of experts selected from professors of educational administration. The inventory contained three parts: Planning the Program of Preparation, Executing the Program of Preparation, and Evaluating the Program of Preparation. Questions were largely of the multiple-choice variety, with an opportunity for free response in each. Nearly half of the instrument, in terms of pages, was devoted to open-ended questions regarding "staff perception of changes that had occurred, and their significance."

Supplementary sources of data were two series of interviews with representatives from the cooperating institutions, and descriptive materials provided by the participating universities. The interviews were conducted during the annual meetings of the National Conference of Professors of Educational Administration (NCPEA) in 1958 and 1959.

In the conclusions, three of the original hypotheses were verified by the data: i.e., that changes have occurred in the preparation programs for educational administrators at all of the institutions studied; that patterns or trends which are common to all of the Center universities are emerging or have emerged; that patterns or trends that are not common to all of the Center universities are emerging or have emerged.

Contrary to what had been anticipated, the patterns of curriculum change in these institutions of higher learning are unique to the respective institutions involved. Furthermore, rather than discovering that curriculum change takes place on a basis consistent with a previously planned order and design, it was found that change occurs on a broken front and is often controlled by the exigencies of the current situation.

Other conclusions point up the prominent role of research and experimentation in bringing about curriculum change at the graduate level, and the increased use of program evaluation as a device for perpetuating improvement. Twelve significant changes that have occurred during the



CPEA years were cited, and ten conditions which seem to have played an important part in producing these changes were named.

The analysis of the data is followed by an attempt to postulate areas of program improvement which seem likely to follow the current stages of development; ten such items are listed. The study concludes with five recommendations for further study which might shed new light on accepted knowledge, provide additional knowledge in needed areas, and pave the way for further research.

Microfilm \$4.75; Xerox \$16.90. 372 pages.

#### TEACHING PERSONNEL FOR THE CHURCH RELATED COLLEGES OF THE SOUTH

(L. C. Card No. Mic 60-4631)

William Donald Clague, Ed.D.  
University of Virginia, 1960

The general objective of this study was the discovery of sources and procedures for obtaining teaching personnel for church related colleges of the South as well as certain influences affecting recruitment and retention of teachers for these colleges. Specific purposes contributing to this objective were the following:

1. Identification of factors which influenced college teachers in the South to choose college teaching as a career and to choose the colleges in which they taught.
2. Identification of differences between these factors for teachers in church related colleges and for teachers in non-church related colleges.
3. Identification of procedures utilized by college administrators in recruiting teachers.
4. Identification of the period in their lives when individuals decided to become college teachers.
5. Evaluation of certain procedures for securing and maintaining a college teaching staff.
6. Identification of promising procedures for increasing the number of college teachers.
7. Identification of promising procedures for recruiting and maintaining adequate teaching staffs for church related colleges of the South.

Two questionnaires were the principal sources of the data. One questionnaire was completed by a random sample of the teachers of the accredited four-year colleges of the South. The other was completed by the presidents of these colleges. Data from personnel of church related colleges were presented separately from and compared to data from the other colleges. Statistical analyses included the computation of measures of central tendency and weighted scores and the application of chi-square techniques to test apparent relationships between variables.

The main findings of the study included the following:

1. Important influences in the choice of college teaching careers were the following: prestige of the career, benefits other than salary provided by the career, encouragement by college teachers and administrators, security offered in the career, opportunity to work with college age youth, and opportunity to live and work in a pleasing social, cultural, and geographical setting.
2. Choices of the college in which to teach were based

upon the following: recognition of the colleges by professional groups and accrediting agencies, work loads, opportunities for research, facilities for teaching, and salary scales. Positions in church related colleges were often selected because of loyalty to that type of college and because such positions were viewed as opportunities to serve the church and to make close contacts with students.

3. College presidents of the South used about the same procedures for recruiting teachers. Church agencies often were of assistance to presidents of church related colleges. Recommendations of faculty members were utilized more frequently by presidents of non-church related colleges.

4. The majority of decisions to enter college teaching as a career were made after undergraduate study.

5. Longer periods of service tended to accompany the following conditions: administrative support in building departments, recognition for tasks well done and for special achievements, freedom in academic and non-academic life, assurance of security in positions, satisfying college objectives, and promotion of public appreciation for the services performed by college teachers.

6. Procedures judged to be valuable for increasing the number of college teachers were the following: raising salaries, recommending to students that they consider careers as college teachers, and demonstrating the rewards of college teaching.

7. Procedures specifically identified as having value for increasing the number of teachers for church related colleges were the following: raising salaries until competitive with those of other colleges, increasing fringe benefits, encouraging students in church related colleges to prepare to teach in these colleges and offering financial aid for such preparation, supporting the idea that teaching in these colleges is a meaningful service, providing for teachers to teach in their fields of specialization, and decreasing work loads.

Microfilm \$3.70; Xerox \$13.05. 287 pages.

#### THE FLINT BUILDING DIRECTOR: ROLE EXPECTATIONS HELD BY RELEVANT GROUPS.

(L. C. Card No. Mic 60-3410)

Alton Walter Cowan, Ed.D.  
Michigan State University, 1960

Major Professor: Fred Vescolani

#### The Problem

The Flint, Michigan Board of Education has created a unique staff position, the community school building director. The purpose of this study was to identify and clarify role expectations held by building directors, principals, adult education co-ordinators, and teachers regarding selected aspects of the position in the Flint community school structure.

It was assumed that this new position would be defined differently by the various groups of Flint educators, thus creating possibilities of role conflict. Selected personal variables were also hypothesized to be systematically related to role expectations held by the role definers.

### Procedure

Building directors, principals, adult education co-ordinators, and a stratified random sampling of teachers were sent a questionnaire regarding 74 selected aspects of the building director's professional roles. The roles were: 1) as a teacher; 2) as an administrator of the community school; 3) as a professional staff member; and 4) as a co-ordinator of school and community relations. The respondents indicated if they believed the building director should or should not do what was described in the selected situations and building directors were asked to define expectations held by the significant others.

Seven questions which asked for information pertinent to role clarification and general questions concerned with personal data were answered. Role expectations of the respondent groups were compared and convergence and divergence of beliefs noted.

### Findings

The analysis of data supported the hypothesis that building directors and significant others hold different and sometimes conflicting expectations regarding the selected aspects of the position.

Principals and adult education co-ordinators held a better image of the building director's position than did teachers. Likewise, building directors were able to define expectations held by principals and adult education co-ordinators better than expectations held by teachers.

Significant convergence-divergence of affirmative expectations held by the various groups was computed by the chi-square statistic. In the 74 selected situations, the affirmative expectations of building directors were in agreement with adult education co-ordinators in 64 items and with principals in 61 items. Building directors and teachers were in agreement on only 41 items.

Building directors' expectations and definitions of others' expectations were in agreement with adult education co-ordinators', principals', and teachers' expressed expectations in 64, 58, and 26 of the 74 selected situations, respectively.

The building directors held an inaccurate definition of teachers' expectations in 15 items and of principals' expectations in three of the items, thus creating conflicting expectations where none existed.

In 33 items with teachers, nine with principals, and seven with adult education co-ordinators, the building directors accurately defined divergent role expectations.

In four items with principals and three with adult education co-ordinators, divergent expectations were held, and building directors failed to identify the extent of disagreement.

A rank-difference correlation of preferences of respondents regarding the questions requesting additional information, demonstrated that building directors, principals, and adult education co-ordinators were significantly in agreement on three items. Significant relationship was noted on only one item between the preferences of building directors and teachers.

A summation of recorded statements also revealed a need for role clarification.

A comparison of selected personal variables of the relevant groups with regards to the proportion of respondents defining the position and holding affirmative expecta-

tions failed to support the assumption that systematic relationships would be discovered.

### Recommendations

To reduce possibilities of role conflict, attempts should be made to help building directors, principals, adult education co-ordinators, and teachers reach agreement in defining the building director's professional roles.

An in-service education program designed to acquaint the building director with others' expectations and to encourage an understanding of what is expected of him, is recommended. The building director should also have an opportunity to communicate to significant others what he believes is appropriate behavior in these selected situations.

Adequate channels of communication between the building director and his reference groups should be maintained if there is to be an increase in convergence with regards to role expectations. Educators at all levels in the Flint system should be aware of the convergent and divergent role expectations revealed by this study and seek ways of reducing open and potential conflict.

Microfilm \$2.55; Xerox \$8.80. 195 pages.

### THE INFLUENCE OF THE PLANNING PROCESSES UPON THE SUCCESS OF MERIT SALARIES FOR TEACHERS

(L. C. Card No. Mic 60-4632)

Robert Carl Gibson, Ed.D.  
University of Virginia, 1960

The purpose of this study was to determine what conditions and planning procedures were conducive to success of merit salary systems for teachers. Merit salaries were defined as salaries based in part upon evaluation of the work of teachers.

Review of the literature and correspondence with State Superintendents and with Executive Secretaries of the State Teachers Associations in fourteen northeastern states revealed sufficient merit pay systems to permit this study to be narrowed to six states: Connecticut, Delaware, Maryland, New Jersey, New York, and Virginia. Direct correspondence with local superintendents obtained their participation in thirty-three school systems.

Questionnaires to superintendents determined what steps had been taken in planning these merit salary systems, and obtained evaluation of the influence upon success exerted by each planning step. The planning done was entered on other questionnaire forms and submitted to the principals and general supervisors, who evaluated the effect upon success of each step taken in planning merit salaries in their respective school systems. A total of 211 superintendents, principals, and general supervisors responded to the questionnaire.

Respondents indicated the influence of each planning step upon success of the merit salary system. Responses were tabulated and arithmetic means were computed for all evaluations of the contribution of each planning step upon success of merit salary plans. Mean evaluations for each



planning step from personnel in "successful" and "unsuccessful" systems, and from respondents in large, medium, and small school systems, provided evidences of total influence upon success, and of influence which varied among the three size categories of school systems. Major conclusions are presented here in four sections to conform to the four stages in the development of merit salaries.

Within a permissive state level framework, local stimulus and support provide greater influence toward success of merit salaries than does state level promotion. The group responsible for developing merit salaries in any school system should seek the support of local groups throughout the planning period and after merit salaries are placed in effect. Provisions for adequate base salaries and for the increased funds necessary to institute merit increments are prerequisite to optimum conditions for success of merit pay plans. Teacher opposition had an effective influence toward failure of merit pay plans. In light of this, it appears advisable to consider predominant teacher opinion as plans develop.

The planning committee should include classroom teachers selected by their fellows, some of whom officially represent the local teachers' association. The local teachers' association should be consulted throughout the planning process. The superintendent should relinquish leadership on the planning committee to a chairman selected by the group. The functions and limitations of the planning committee should be initially identified, constantly redefined, and pursued with freedom within the framework of those functions and limitations. Among those functions should be familiarization with merit pay research and practice, polling opinion, recommending on the advisability of merit pay, and actually planning a merit pay system.

A period of at least two years should be spent in devising the plan for merit pay. Teachers should help in formulating procedures for evaluating the services of staff members. The community should be provided opportunity for approving the merit pay plan.

The merit pay plan in operation should be considerate of teachers, permitting teacher appeal, and providing constructive counsel and full information to all concerned. A representative committee should study the operation of the merit pay plan. A trial period should be established at the outset, with discontinuation planned if and when that is propitious. Microfilm \$4.00; Xerox \$14.20. 312 pages.

#### FACULTY PARTICIPATION IN BUDGETARY ADMINISTRATION IN LARGE PRIVATELY CONTROLLED UNIVERSITIES

(L. C. Card No. Mic 60-3744)

Bryghte David Godbold, Ph.D.  
New York University, 1960

#### The Study

During the 1960's, a large increase is anticipated in number of college students and costs of higher education. Authorities estimate that the increase will approximate 100 per cent.

As the impending surge in enrollment has become more apparent, Americans have begun to question educational

costs. Critics are asking why universities cost so much to operate. Articles are appearing in newspapers and magazines stating that higher institutions are inefficient and unbusinesslike. Within the educational world itself, there is more interest in operating costs.

Paralleling the increased awareness of educational costs is an increase in democratic administration. Faculty members are playing a larger role in policy formulation; students are being consulted more extensively on institutional problems, and alumni views are being sought more actively.

The two trends--growing awareness of educational expenditures and increased democratic administration--lead to the question: is democratic administration of universities compatible with economical operation?

In the study, the answer to this general query was sought by investigating the effectiveness of faculty participation in university budgetary administration. Specifically, the researcher sought to answer this question: is there a close relationship between extent of faculty participation in budget development and revision and the proportion of funds spent on educational activities?

The assumption was made that a high ratio of expenditures for educational activities to expenditures for noneducational activities is a desirable goal in allocating university funds.

#### Conduct of the Study

The study was conducted in privately controlled universities granting the Ph. D. degree, with more than 5,000 students, and a liberal arts school and three or more professional schools. In 1957-58, there were eighteen such universities, and a sample of nine was selected.

The investigator visited the nine institutions, conferring with administrative officers and faculty members to determine extent of faculty involvement in budget formulation and revision. Data were also obtained on 1957-58 expenditures and used to compute percentage of expenditures by each institution on educational and on noneducational activities. Standings of the universities were computed based on extent of faculty participation and percentages spent for various activities. Coefficients of correlation were calculated to derive indexes of relationship.

#### Findings

Little faculty participation was found in budget development and revision. The extent varied considerably; however, no substantial faculty involvement was found in any university.

A very low correlation (+.37) was found between extent of faculty participation in budget development and revision and proportion of funds spent for educational activities.

It was found that faculty involvement in budgetary administration was increasing; there were no indications of diminishing participation.

An interesting relationship was discovered between organization and resource allocation. A +.63 correlation was found between extent of control of budgetary administration by the chief university educational administrator and proportion of funds expended for educational activities. A higher correlation (+.73) was found between extent of control of budgeting by a "neutral" administrator (as opposed to control by either an educational or a business

officer) and proportion of funds devoted to educational activities.

#### Conclusions and Recommendations

One factor which contributed to the little faculty participation in budget development and revision was the negligible participation in income estimation, budget review, and budget revision.

The very low correlation (+.37) does not justify a conclusion that there is close relationship between faculty participation and university resource allocation. However, the finding of increased participation does justify a recommendation for further study.

The moderate correlation between control of budgetary administration in the university staff and allocation of funds justifies a recommendation that universities seek to give more budget authority to the chief educational officer or to a neutral budget official.

Microfilm \$2.50; Xerox \$8.60. 186 pages.

#### ORIENTATION PROGRAMS IN SELECTED SCHOOL DISTRICTS AND THEIR RELATIONSHIP TO THE PERCEPTIONS OF BEGINNING TEACHERS

(L. C. Card No. Mic 60-3400)

Joseph Thomas Hudson, Ed.D.  
Michigan State University, 1959

Major Professor: Karl T. Hereford

The problem of this study was to determine the perceptions held by beginning elementary teachers from selected Michigan school districts of their own orientation experiences in relation to the problems which they perceived during their initial year of teaching.

In order to study the problem, information was gathered by use of a questionnaire from 137 beginning elementary teachers in the selected Michigan school districts.

The characteristics of the beginning teachers included in this study were similar to those of teacher groups in Michigan and the United States. Eighty-five and four-tenths per cent of them were women between the ages of twenty and twenty-five years. Over half of them had majored in elementary education, lived within the community in which they taught, and were planning to teach in the same school the following year.

This study presented data which revealed the statistically significant relationships in the following hypotheses:

1. Beginning teachers of different social groups, such as those based on age, sex, undergraduate major, residence, as well as those who have had different student-teaching and teaching experiences do not differ with respect to perception of problems on human relations, on mechanics of teaching, of professional aspects of their positions, and of the community.

2. Beginning teachers perceive different sources as helpful for different types of problems.

3. Beginning teachers perceive the orientation procedures used in their schools as helpful in some types of problems.

4. The orientation procedures do not meet all types of problems perceived by the teachers.

5. Teachers recommend many different types of orientation procedures which they do not perceive in the present orientation programs.

The conclusions were:

1. Present orientation programs deal with aspects of teaching which are of minor importance to beginning teachers.

2. The present orientation practices mainly provide information to help in coping with problems involving the administrative details of teaching.

3. The chief concern of beginning teachers is with problems involving human relations in the classroom.

4. By the end of the year beginning teachers are concerned not only with classroom relations but also with the broader school and community problems.

5. The beginning teacher seems to turn most frequently to experienced colleagues and the school administrator for assistance in solving all types of problems.

6. Despite the fact that present procedures are not always considered helpful by beginning teachers, they nevertheless recommend them for other beginning teachers.

7. Almost half of the teachers who majored in secondary education are now working in elementary schools.

It is recommended that:

1. A new concept of orientation is needed.

2. The persons involved in the development of programs should be changed.

3. The focus of orientation programs should change.

4. Orientation procedures should be changed.

5. The basis for evaluating orientation programs should be changed.

6. The role of the administrator in orientation should be changed.

7. Special procedures should be provided.

8. Further research is needed.

Microfilm \$2.50; Xerox \$8.00. 175 pages.

#### COMPARATIVE COSTS AND UTILIZATION OF PERMANENT AND TRANSPORTABLE CLASSROOMS

(L. C. Card No. Mic 60-3785)

Francis Dean Largent, Ed.D.  
Stanford University, 1960

The purpose of this study was: (1) to compare and analyze the initial construction costs of portable and permanent classrooms, (2) to determine costs of moving portable classrooms, (3) to secure costs of converting portable classrooms into permanent structures, and (4) to survey current practices in the utilization of portable classrooms in California schools.

Initial construction cost data were secured from construction contract records for 389 portable elementary classrooms and 140 permanent elementary classrooms.



Costs were corrected for economic fluctuations by the use of a cost index and adjusted by correction factors to exclude facilities other than classrooms. The significance of the variation was determined statistically for items that could not be excluded. Cost data were gathered for 117 portable classrooms moved off-site, and for seventeen classrooms moved on-site. Costs of sixty-nine classrooms converted from portable to permanent buildings were secured also. Current practices in the use of portable buildings in California schools were reported on the basis of respondents to 213 mailed questionnaires. The sample was stratified by district size and region.

Since all cost data were secured from the Los Angeles City School District, conclusions based upon the study are regarded as specific to the district. Current practices reported are specific to the State of California.

The results of this study show that the initial construction cost of portable classrooms was \$7.84 per square foot as compared to \$13.22 per square foot for permanent classrooms. When the costs of converting portable classrooms into permanent structures were considered with initial construction cost, a range of \$11.22 to \$22.02 per square foot per portable classroom was found. Rapid construction and flexibility in meeting pupil housing needs due to ease of moving classrooms are advantages gained, even though the cost may exceed permanent classroom cost. Several variables were found to be related to the initial costs of both portable and permanent classrooms. The investigation of the costs of moving portable classrooms revealed that the mean total cost of moving each classroom was \$1,047.50 when six classrooms were moved at a time. When one classroom was moved the mean cost per classroom was \$2,908.11. Costs of converting portable classrooms into permanent structures varied greatly with the particular conversion job since many factors affected these costs. The range of adjusted square foot costs per room was from \$3.38 to \$14.18. Of the total number of classrooms in districts in California over 10,000 A.D.A., 16.83 per cent were portable classrooms. Portable classrooms were utilized by 82.9 per cent of the total number of districts of this size. Population mobility was ranked first the largest number of times by school officials as the most important factor considered when contemplating the use of portable classrooms.

In general, it was recommended that the data reported serve as background information for school planners responsible for the educational housing needs of a community. Specific recommendations were that: (1) all school districts consider the use of portable classrooms in their over-all building program; (2) portable classrooms be looked upon as a supplement to, and not a substitute for, permanent classrooms; (3) portable classrooms be utilized as transportable classrooms and moved as frequently as needed; (4) permanent service facilities be constructed in addition to portable classroom buildings on a site; and (5) permanent classrooms for the maximum predicted permanent pupil population be used to replace portable classrooms in long-term planning.

The study shows that portable classrooms can provide a current means to wise spending, and at the same time meet the educational housing needs with a well-planned, long-term program.

Microfilm \$2.50; Xerox \$7.20. 151 pages.

THE ORGANIZATION AND ADMINISTRATION  
OF THE PROGRAM OF VOCATIONAL  
EDUCATION IN PRIVATE TRADE SCHOOLS  
FOR NEW YORK STATE: AN ANALYSIS  
OF THE LAWS AND REGULATIONS OF  
THE SEVERAL STATES CONCERNING  
PRIVATE TRADE SCHOOLS RESULTING  
IN AN ADMINISTRATIVE HANDBOOK.

(L. C. Card No. Mic 60-3772)

John M. Leslie, Ed.D.  
New York University, 1960

Chairman: William P. Sears

Purpose:

The purpose of this study was to investigate the regulations, policies and procedures used to implement the administration of Section 5001 of the New York State Education Law entitled, Private Trade Schools, and to investigate similar laws, regulations and practices of other states. The purpose of the investigation was to formulate a plan in the form of an administrative handbook to assist the proprietors and administrators of private trade schools in the resolution of existing problems and contribute to the solution of probable future problems. It was the additional purpose of this study to prepare a guide for the supervisory staff of the Bureau of Private Trade and Correspondence Schools to aid in the achievement of uniform and equitable application of the regulatory functions of that Bureau.

Methodology:

The data used for the study consist of the statutes, regulations, standards, administrative forms, and published policies and procedures of those states which exercise control over private trade schools as a type of institution. In addition, data were obtained for New York State from directives to schools, inter-staff memorandums and selected communications to school administrators which reflected policies and procedures, and original manuscripts of the annual reports of the Bureau of Private Trade and Correspondence Schools.

The directors of vocational-industrial education of the several states were requested to furnish copies of the laws and regulations, if their respective states had enacted such laws. Those states which have laws were requested to furnish any additional materials which were available. The data were reviewed and paraphrased statements of the provisions were returned to each state to be examined for accuracy.

From the files of the Bureau of Private Trade and Correspondence Schools, a composite list of policies and procedures used in New York State was prepared. These data were classified under the appropriate sub-paragraphs of the Regulations of the Commissioner of Education, Section 196.

A preliminary draft of the handbook was prepared and submitted to three persons who own and operate private trade schools and two persons in the New York State Education Department responsible for administration of the law and regulations. The comments and recommendations of the jury were incorporated in the final draft of the handbook or if not provided for in the statute or regulations,

they were included as recommendations for amendment of the statute or regulations. Selected provisions of other states provided data for recommendations to modify the statute or regulations of New York State.

#### Results:

The study resulted in an administrative handbook with ten sections: Section I - License Required: Licensing Procedure, Section II - Resources, Section III - Housing and Equipment, Section IV - Administrative Staff and Teachers, Section V - Standards and Methods of Instruction, Section VI - Enrollment Agreement or Contract, Section VII - Records, Section VIII - Advertising, Section IX - Conduct of the School, and Section X - Approval for Training Students Under Federal and State Statutes.

Each section is prefaced by the appropriate provisions of the statute. The regulations are quoted and implemented by applicable standards, policies and procedures. The handbook includes sample forms and suggests administrative practices to be followed for compliance with the law and regulations.

The study served to emphasize the need for recommendations to clarify and strengthen the existing statute and regulations. Recommendations were under the same categories as were used to identify the sections of the handbook. The study indicates the need for flexibility in the private trade schools as contributors to the program of vocational education.

Microfilm \$3.95; Xerox \$13.95. 308 pages.

#### SCHOOL-COMMUNITY STUDIES AND SOCIO-ECONOMIC CLASSES OF SEVEN SELECTED MICHIGAN COMMUNITIES

(L. C. Card No. Mic 60-3419)

Daniel Roy McLaughlin, Ph.D.  
Michigan State University, 1960

Major Professor: William H. Roe

Becoming active in and reading about school-community studies can lead one to believe that involving citizens in public schools will solve most all educational problems. This dissertation is an attempt to assess certain tangible and intangible results that school-community studies accomplish. Specifically it concerns itself with the opinion and understanding of education held by different socio-economic classes of seven Michigan Communities, two of which had undergone the process of a school-community study. These two communities were labeled "studied" communities while the remaining five communities were called "unstudied."

Data for this dissertation were obtained from two sources. First, data were made available from the five Michigan communities which were involved in a public opinion survey conducted for the Michigan Communications Study. This was a cooperative interdisciplinary project of the Midwest Administrative Center, University of Chicago, and Michigan State University. The primary concern of the Michigan Communications Study was communications and public opinion of education. To date the study is

unpublished. Second, the writer gathered similar type data from a random sample of the population of two additionally selected Michigan communities.

The methodology used for gathering data for this dissertation followed that established by the Michigan Communications Study in their public opinion survey. This consisted of using a schedule of selected questions in an extensive personal interview with a random sample of the selected community's population. In this dissertation the schedule of questions used in the personal interviews was made up from pertinent sections of the personal interview questionnaire developed for the Michigan Communications Study by the Social Research Service of Michigan State University.

The hypothesis proposed in this dissertation states:

Socio-economic classes within communities which have undergone the school-community study process will be more favorable to education and know more facts about their local school than similar socio-economic classes in communities which have not undergone this process.

The hypothesis was tested by:

1. Percentage differences on data received from open-end questions.
2. The Chi Square Test on data received from closed-end questions. Significance of Chi Square was accepted at the .05 level providing there were at least five cases in all cell expected.

An analysis of data obtained in the study reveals only minor differences between studied and unstudied communities in knowledge and opinion of socio-economic classes. The following four areas are significant according to tests used:

1. The upper socio-economic classes of the school-community "studied" communities were more favorable to the amount of time their school spent on drama than were similar class members in the "unstudied" communities.
2. Middle socio-economic class members from "studied" communities desired larger school classes than similar class members in "unstudied" communities.
3. A majority of all respondents were favorable to present educational expenses. However, middle and lower socio-economic class members from "studied" communities responded in a negative manner to questions concerning costs of education significantly more often than similar class members in "unstudied" communities.
4. The lower socio-economic classes from "studied" communities desired more homework for their students and felt that their classrooms were crowded. Similar classes in the "unstudied" communities were satisfied with the amount of homework and the number of students in their classrooms.

The hypothesis cannot be entirely rejected from the data received. However, the extent to which the results reject the hypothesis clearly demonstrate that the school-community studies conducted in the two "studied"



communities involved in this dissertation did not serve as educational "cure-alls" for these communities.

Microfilm \$3.65; Xerox \$12.85. 282 pages.

# THE RELATIONSHIP OF SCHOOL PLANT EXPENSE AND BUILDING COMPACTNESS IN ELEMENTARY SCHOOL BUILDINGS

(L. C. Card No. Mic 60-3786)

Robert Eon McLean, Ed.D.  
Stanford University, 1960

This study looks at variations in the design of school plant for possible consequences in subsequent operation and maintenance expense. Specifically, it orders variations in design on a continuum through use of an index of compactness and relates position on this continuum to the expense of operating and maintaining the plant.

## Importance of Problem

Operation and maintenance expenses, defined as plant expense, are a part of current operating costs. Money used to pay school plant expense certainly adds to the cost of education and may reduce the funds available for instructional programs. Therefore a study designed to identify ways of reducing school plant expense is of significance to all school personnel as well as to those who provide the funds for the public schools. This study seeks possibilities for such reductions in improved school design.

## Research Design

The design of this study involved steps as follows: (1) selection of a representative sample of elementary schools; (2) collection of data on perimeter of the buildings; (3) collection of data on plant expense; (4) collection of data on square footage of the building; (5) identification and collection of data on other variables which could logically be associated with plant expense; (6) calculation of the statistical relationship between compactness of the building and plant expense; and (7) estimation of the effect on this relationship of additional variables.

The measure of compactness used in this study was the outside perimeter divided by the enclosed square footage of the building. Since all the buildings were one story, the index of compactness served as an adequate measure.

School plants built during the fiscal years 1949 through 1953 were selected for the study. The expense of maintaining and operating these plants for each of the five years studied, 1954-1958, was divided by the number of square feet of construction on that site for that specific year to derive an annual plant expense per square foot. These five annual plant expenses were averaged to compute the plant expense index for that school. The gross plant expense was achieved by totaling the five annual plant expenses.

Other variables analyzed for relationship to plant expense included area in group activity space; arcades and pavilions; sidewalks and driveways; site; lawn, flowers, and shrubs; number of sessions; topography; and restroom partitions.

## Statistical Analyses

Three major statistical analyses were used: the part correlation coefficient, the product-moment correlation, and the difference between means. Resort was made to the part correlation technique in order to avoid an element of spurious correlation that results from correlating two indices (plant expense and compactness) that have a common variable denominator. This same technique was used to see if group activity space might affect the foregoing relationship. The product-moment correlation and the difference between means were used to analyze the relationships between plant expense and the other variables.

## Conclusions

The conclusion was drawn that there is a significant inverse relationship between compactness of a school building and subsequent plant expense when square footage is partialled out of plant expense. The part correlation coefficient was -.41 which is significant at the .05 level. However the relationship (-.20) is no longer significant at the .05 level when square footage and group activity space are partialled out of plant expense. Approximately 17% of the variance of plant expense is associated with the variability of compactness.

The other variables identified as having a possible effect upon the foregoing relationship were found to have no statistical significance.

Microfilm \$2.50; Xerox \$4.00. 73 pages.

# SOCIAL STATUS AND THE PERCEPTION OF PERSONAL-SOCIAL PROBLEMS OF A SELECTED GROUP OF EARLY ADOLESCENTS

(L. C. Card No. Mic 60-3424)

Charles Walter Rutledge, Ph.D.  
Michigan State University, 1960

Major Professor: Floyd G. Parker

**Purpose and methodology.** The purpose of the study was to determine whether there were any significant relationships between the incidence of problems reported by a selected group of early adolescents, and the specific factor of social status as determined by father's occupation. Simple Chi-square analysis was used to test the statistical hypothesis that there are no significant differences in the personal-social problems perceived by early adolescent boys and girls of high, middle, and low social status.

Data was collected on 276 early adolescents, 144 boys and 132 girls, by use of the Mooney Problem Check List, Junior High Form and a Personal Data Questionnaire, from which each respondent's father's occupation was determined. The North-Hatt Scale or Interpolations of it was used to determine the social status of each respondent. The statistical hypothesis was tested for the seven general problem areas and for each of the 210 specific items in the Check List.

**Major findings.** There were a number of significant relationships between social status and the various problem areas and individual items on the Check List. Significant relationships were found for girls in five of the seven

general areas. These were "Health and Physical Development," "Home and Family," "Relations to People in General," "Self Centered Concerns," and "School." Significant relationships were found for boys in two areas "Health and Physical Development," and "Home and Family." For seventh, eighth, and ninth grade boys and girls, and total boys, and total girls, and for various combinations of social status categories and response categories, a total of twenty significant findings resulted in five of the general problem areas. Eighteen were significant for girls while only two were significant for boys. In all instances boys and girls in the high status categories indicated a more favorable response. Thirteen responses were more favorable to middle status groups than to low status groups while seven responses were more favorable to low status groups than to middle status groups.

All but four of twenty-one specific items found significantly associated with social status were favorable to high status groups. Three responses favored middle status groups while only one favored a low status group. The factor of sex was excluded in eight of the twenty-one significant responses.

**Conclusions.** The following conclusions were drawn from the findings: (1) The general problem areas of the Mooney Problem Check List are more adequate for measuring the association of social status to problems of early adolescents than are the specific items. (2) The factor of sex is not significant in the number of problems perceived by early adolescents. (3) For early adolescents the impact of status on problem areas is greater for girls than it is for boys. (4) In general, the incidence of problems of early adolescents is greatest for those of low status and lowest for those of high status.

**Recommendations for further research.** Some recommendations for further research were: (1) Studies of a similar nature should be undertaken in schools with different kinds of internal organization, and in communities with different patterns of social stratification. (2) Similar studies should be more rigorously designed, with the sample being larger and more truly random.

**Implications for education and educational administration.** The following implications for education and educational administration were suggested: (1) The findings suggest the need for faculty and administrative study of curriculum development with curriculum revisions adjusted to the respective needs of the different status groups. (2) The findings suggest new approaches in guidance and counseling for helping youth solve their problems. (3) The findings suggest that policies and decisions should take into consideration the values of all social strata. (4) Knowledge of values, modes of conduct, and problems of the various social strata should be of practical importance to administrators in the selection of new personnel, in making in-service programs more effective, for improving extra curricular activities, and in increasing the schools holding power. Microfilm \$2.50; Xerox \$5.80. 120 pages.

## PATTERNS IN THE DECISION MAKING PROCESS OF A SCHOOL BOARD

(L. C. Card No. Mic 60-3787)

Donald Paul Shock, Ed.D.  
Stanford University, 1960

The problem undertaken was to identify, if possible, the patterns followed by a school board in making policy decisions, and whether these patterns vary with the nature of the problem. The study was concerned with answering three questions:

1. Is there a pattern by which the subject school board arrives at a decision?
2. Does the pattern vary with the type of problem?
3. How do the patterns used by the subject board relate to the findings of previous studies of school board decision making?

Neither the effectiveness of the decisions, the actions of the individuals, the appropriateness of the patterns, the sociology of the community, the interaction process of the group, nor the role playing of the individuals involved was considered.

The basic technique was the observation and recording of behavior. An Action Chart was devised for tabulating, codifying and utilizing the data obtained. The chart contained thirteen types of actions that the board was observed to take during the one year term of the study. These actions follow a graduated range from "Board Accepts Superintendent's Recommendation Without Question," through "Board Rejects Superintendent's Recommendation Summarily" and "Board Tables Item," to "Board Drops Item Without Decision or Formal Action." Specific working definitions were formulated to govern the placement of actions.

All agenda items were divided into eight categories: minutes, finances, personnel, buildings and properties, curriculum, field trips, miscellaneous, and "add-to" items.

As each item (468 in all) came before the board the observer recorded the following data: the number of questions asked, number of comments, amount of debate, and whether it was accepted, tabled, or rejected. All items regardless of category were tabulated on a single action chart to determine if there was a primary pattern of decision making employed. A second tabulation was made for each of the eight categories to see if the pattern varied with the nature of the problem. A third tabulation was made in the case of "add-to" items to determine if the pattern followed in deciding these differed from any other.

The more important findings and conclusions are:

1. There is a definite pattern followed by the subject school board in reaching its decisions. When all actions regardless of type are considered together, this board followed the pattern of accepting the superintendent's recommendation on 86% of the agenda items. This appears to lend validity to the statement that a school board looks to its superintendent for leadership and guidance in making decisions.
2. There are variations in the primary pattern. These are related to the type of problem, as shown



by the Chi-Square Test. The following variations were noted:

- 2.1 Building & Properties. The board did not accept the superintendent's recommendation on these items without some question.
  - 2.2 Personnel. While the board accepted the recommendation without question on matters relating to employment, it questioned the superintendent at length on resignations and dismissals.
  - 2.3 Curriculum. The board questioned the superintendent intensively on these items and engaged in lengthy discussion and debate.
  - 2.4 "Add-To" Items. The board tended to question the superintendent and to debate and discuss these items at length. There was a pattern of rejection of the superintendent's recommendation that was not present in any other category.
3. The pattern employed in making decisions on financial matters when compared with the patterns used in deciding curriculum matters appears to be in conflict with some commonly accepted precepts of educational administration.
  4. There was little relationship between the patterns of decision making employed by the subject board and the pattern reported in the one other study of school board decision making discovered.

Microfilm \$2.50; Xerox \$8.40. 182 pages.

#### ATTITUDES TOWARD DISCIPLINE IN COLLEGE

(L. C. Card No. Mic 60-3780)

Bette Jean Soldwedel, Ed.D.  
New York University, 1960

Chairman: Assistant Professor Martin Hamburger

#### The Problem

This study had as its purpose the discovery and examination of attitudes of offenders toward college discipline and selected variables. The specific problems were:

1. To determine offenders' attitudes toward discipline;
2. To show the relationship between these attitudes and the variables of sex, school year, perception of self as a church-goer, intelligence, and certain personality variables;
3. To develop appropriate recommendations for the administration of discipline based on a knowledge of offenders' attitudes and the selected variables.

#### Procedure

To determine attitudes toward discipline, each offender disciplined by a student government group at Trenton State

College during the first semester, 1958-1959, was individually interviewed. Expressions of attitudes were classified as: accepting, rejecting, ambivalent. 81 cases were identified from a total college enrollment of 1450. Examining the sample group and the total enrollment, several differences were noted: (1) there were more women offenders than women were represented in the total enrollment; (2) there were more junior and senior offenders than juniors and seniors were represented in the total enrollment; (3) there were more health and physical education majors involved in discipline than health and physical education majors were represented in curricula distributions; (4) one-fourth of the total number of discipline cases came from two New Jersey shore resort counties while these counties contributed only ten percent to the total college enrollment.

The three attitude groups - accept, reject, ambivalent toward discipline - were (1) classified according to sex; (2) classified according to school year; (3) rated on a Church-attendance check-list; (4) divided into four quartile groups on the basis of total scores on the School and College Ability Test; (5) administered the Edwards Personal Preference Schedule for which percentile scores were obtained. The factors of sex, school year, perception of self as a church-goer, and intelligence and the three attitudinal groups were treated by Chi square. The three attitude groups and the personality variables were treated in the following manner. Means were computed for the three attitude groups. A "t" test was applied, comparing Accept-Reject; Accept-Ambivalent; and Reject-Ambivalent groups.

#### Results

No statistically significant relationships were found to exist between a given attitude and each variable selected for study. Inasmuch as discipline is considered a normal part of college life, administrators need to examine behavior determinants associated with discipline incidents. From this investigation, no clear cause-and-effect relationships were observed between attitudes toward discipline and selected variables.

#### Recommendations Relating to Discipline Administration

College Regulations. In the light of objectives of the college to develop mature and responsible citizens, college regulations should be examined. Regulations, necessary for orderly group living, must reflect the maturity of the college student. As a natural concomitant, then, to the development of mature and independent college students, regulations must allow for individual freedom of thought and movement in the college community.

Student Government. Assumptions regarding the role of student government in discipline administration need to evolve from an awareness of "attitudes of the governed" as well as from a theoretical framework. Student government groups at Trenton State College need to examine means of communicating with and involving all constituents. The techniques of interpreting representative government to the uninvolved student must become a major focus of those elected to office. Unless student government can shift from "authority" to "representation," there is little likelihood that college-held values will be made significant to the individual student.

Microfilm \$2.60; Xerox \$9.00. 199 pages.

**A COMPARATIVE STUDY OF TWO GROUPING PROCEDURES IN THE JUNIOR HIGH SCHOOL ON MEASURES OF ABILITY AND ACHIEVEMENT IN MATHEMATICS AND ENGLISH**

(L. C. Card No. Mic 60-3427)

Mildred Emily Sommers, Ed.D.  
Michigan State University, 1960

Major Professor: Fred Vescolani

**The Problem**

Recent educational developments in this country continually have emphasized the importance of individual differences in learning. There are many conflicting and confused opinions relating to the classification and grouping of pupils for instruction. This study attempted to measure pupil growth in achievement as the result of a program which, for two years for 291 pupils through seventh and eighth grades, grouped pupils and emphasized adaptation of instruction to varying levels of ability and to differing rates of progress. The total class of seventh grade pupils in the fall of 1957 at Frost Junior High School, Jackson, Michigan, was chosen as the experimental group. The total class of 236 eighth grade pupils in the spring of 1957 at Frost Junior High School was used as the control group. No effort had been made to attain homogeneous grouping with respect to achievement or progress in the control group.

It was hypothesized that progress grouping in English and in arithmetic would reduce the wide range of differences for instruction in a limited class period and would facilitate the adjustment of teaching methods and curriculum content to the needs of individuals in the particular group.

The objective was to encourage and permit each pupil in the experimental group to progress for two years along a continuum of subject learning in English and in mathematics at a rate and to a depth commensurate with his ability. It was hypothesized that as this program progressed there would be a high correlation between potentiality and achievement for these pupils.

This study necessitated a project that would provide in-service training for junior high school teachers to prepare them to implement the program and to plan adequate communication with pupils, teachers, parents and other citizens concerning its aims.

**Methods and Procedures**

The first step was to find criteria for the establishment of groups of pupils for instruction with as much homogeneity of progress in learning in English and in mathematics as possible. A classification information card devised for use in sectioning the experimental group contained data on scholastic aptitude and achievement, teacher opinion in the form of the estimated progress level at the close of the school year, and an evaluation of the general quality of work and the pupil's position (high, average, low) within his present progress group.

Teachers and supervisors evolved an educational program in English and in mathematics for pupils in the experimental group that (1) would permit each pupil to progress through the developmental program at his own rate of learning, (2) made provision for broad flexibility in methods and materials to meet individual differences in needs and achievement.

In order to make comparisons of achievement in the two types of groupings, it was necessary to have measures of ability and performance of both the experimental and the control group. The following tests were completed by both the experimental and control groups: the Verbal Reasoning and Numerical Sections of the Differential Aptitude Tests, the Cooperative English Test and the California Arithmetic Achievement Test. Members of the experimental group who had been sectioned heterogeneously for Social Studies were tested in September and again in May for achievement in Social Studies.

The Pearson Product Moment correlation technique was employed to determine if the levels of functioning in the two groups were statistically significant. The means standard deviations and intercorrelations of each of the variables were computed.

Ability levels of the two groups were compared using the t test for the significance of the difference between the means.

The means scores of the two groups on each of the criterion variables were compared using the t test.

An r to z transformation was employed to test the significance of the difference between correlations.

**Findings**

An examination of the findings of this study reveals that while the mean ability scores of the experimental group were lower than the mean ability scores of the control group, the experimental group earned higher mean percentile scores on the vocabulary and comprehension sections of the Cooperative English test and on the fundamentals section of the California Arithmetic test.

It may be inferred from the lack of generally higher achievement by the control group, which had the higher mean ability scores, and from the superiority of performance by the experimental group in certain areas, that the grouping for instruction employed in the experimental group resulted in an improved performance by that group.

A comparison of the correlations earned by the experimental group with the correlations earned by the control group for each variable revealed that in the experimental group there was a closer relationship between the scores earned on the ability tests and the scores earned on the achievement tests.

**Summary**

The problem of meeting individual needs in learning in English and in arithmetic can be at least partially met through grouping procedures. Much of the learning in reading and in arithmetic is sequentially developed and can be taught efficiently to a group if the pupils in the group are ready to learn.

The findings in this study tend to support a contention that the homogeneous grouping in these areas resulted in a higher level of achievement relative to the ability level of the group in question. It may be assumed that the improved performance relative to ability as found in this study may be attributed at least in part to the fact that homogeneous grouping enabled teachers to develop techniques and select materials appropriate to the level of achievement of the group memberships.

Though progress grouping for instruction is feasible in the skills subject area, certain learnings in the Social Studies are a result from the interchange of ideas and



social relationships with others who are both alike and different. The Social Studies test results in the study lead to this conclusion that the experimental group made significant progress in acquiring skills and information and there were sufficient opportunities to provide for individual development without grouping according to achievement and progress in this area.

Microfilm \$2.50; Xerox \$4.40. 85 pages.

### MERIT RATING PLANS FOR TEACHERS

(L. C. Card No. Mic 60-3788)

Lorna Mullen Swain, Ed.D.  
Stanford University, 1960

Merit rating for teachers for salary purposes is a timely, much misunderstood and highly controversial topic.

#### Statement of the Problem

It was the purpose of this study (1) to define merit rating; (2) to trace its history in education, and, to a limited degree, in industry with a view toward comparing developments in the two fields; (3) to furnish examples of merit salary plans now in operation in the public schools; (4) to identify the major issues involved; (5) to suggest research in the problem areas; and (6) in view of experience to date, to propose the major conditions which must be satisfied and hazards which must be avoided before merit rating plans for salary purposes can be effectively introduced.

#### Procedure

The procedure employed in this study consisted of extensive library research during its initial stages to permit the writer to achieve reasonable familiarity with merit rating plans for teachers. Closely related to these merit plans, and considered in conjunction with them, were the various methods of evaluating teacher effectiveness.

A tentative bibliography was developed of all articles dealing with the subject. Perusal of these articles both extended the bibliography and also identified names and locations of schools which were experimenting with merit rating. Personal correspondence was carried on with persons or organizations who reportedly were involved in a discussion of, or possible implementation of, merit rating or were engaged in pertinent research in this area. In many cases a respondent identified other sources.

Finally, after a two year period of investigation, the findings of this study were reported. Of the 192 written requests addressed to specific school districts for information, 138 replies were received; this represents a 71.9 per cent return without a second request.

Certain representative plans and novel approaches to the problem were examined in some detail. Plans were selected by the following criteria: adequacy of information available to the writer, evidence of seriousness on the part of the district in undertaking the program, the length of time the program has been established and operating, and the typicalness or atypicalness of the plan.

### Major Findings

As used in this study, the term merit rating included all the various types of plans by which a teacher's salary is to some extent dependent upon a judgment as to his competence whether or not that judgment stems from a formal rating plan.

For some fifty years merit rating has been a periodic issue in education. Traditionally, many laymen have favored such plans, while professional teachers' organizations have opposed them. Today, there appears to be increasing interest in this problem with some of the experimentation resulting from legislative appropriation or mandate.

### Basic Issues

As a result of this study, certain basic issues emerge: (1) the criterion problem, or definition of good performance in education; (2) method of evaluation, which includes selection and training of evaluators; and (3) professional acceptance of performance as a factor in remuneration which concerns teachers' attitudes toward merit rating.

### Recommendations

In addition to research evolving from these basic issues, a nationwide study of merit rating with professional and lay groups co-operating could provide a research team to travel, examine, interview and study the situational factors, community by community, where merit salary plans are in operation or have been abandoned within the past five years.

Finally, since many school districts are being pushed in the direction of setting up merit plans before needed research can be accomplished, conditions which experience indicates are essential to successful merit programs and hazards to be avoided are proposed in an attempt to offer such districts a measure of needed protection.

Microfilm \$4.25; Xerox \$14.85. 329 pages.

### A STUDY OF THE RELATIONSHIPS AMONG THE FACTORS OF FINANCIAL NEED, EFFORT, AND ABILITY IN 581 HIGH SCHOOL DISTRICTS IN MICHIGAN.

(L. C. Card No. Mic 60-3428)

Merton James Turck, Jr., Ed.D.  
Michigan State University, 1960

Major Professor: Stanley Hecker

The purpose of this dissertation is to determine the relationships between acceptable measures of need, effort, and ability in Michigan public high school districts and the adequacy of the Michigan state financial plan.

To accomplish this, the literature and the research in the fields of school finance and school administration were reviewed to ascertain the elements of a good state support program.

The state support program of Michigan for the 1957-58 school year was examined to determine the manner in

which it provided for the elements of a good program. The assumptions concerning the characteristics of local school districts in Michigan, upon which the state program rests, seemed to be predicated upon some specific relationships among the three key variables of need (size of district membership), ability (taxable wealth), and effort (tax rate).

Three general hypotheses were developed and tested:

I. There is no significant relationship between financial need and financial ability in school districts in Michigan.

II. There is a positive relationship between financial need and financial effort in school districts in Michigan.

III. There is a negative relationship between financial effort and financial ability in school districts in Michigan.

The Pearson product-moment correlation method was used to test the hypotheses. The 581 high school districts were tested as one sample. The 581 districts were also divided into low, medium, and high groups for each variable and tested similarly.

The following results were obtained:

1. It was necessary to reject General Hypothesis I.

A statistically significant positive correlation was obtained for the total sample and for two of the three grouped samples. In only the very small high school district was there no significant relationship between need and ability.

2. It was necessary to accept General Hypothesis II.

For the total sample and for the large high school districts there was a positive relationship between need and effort.

3. It was necessary to reject General Hypothesis III.

For the total sample and for two of the three grouped samples there were no statistically significant relationships. In only the low ability (poor) high school district was there a statistically significant negative relationship.

The following conclusions were reached:

1. There is undoubtedly a relationship between size of membership and taxable wealth.

2. There is a tendency for a school district as it increases in size of membership to expend more effort (tax rate) for the support of its program.

3. There appears to be no consistent relationship between the ability of a high school district and its effort.

4. The three variables studied are by themselves inadequate predictors of the adequacy of a state support program.

5. The effect of sociological factors and various community characteristics may account for the results of the analyses of the variables used in this study.

Microfilm \$3.05; Xerox \$10.60. 233 pages.

**A DESCRIPTIVE STUDY OF THE  
ORGANIZATION, ADMINISTRATION,  
AND OPERATION OF PUPIL PERSONNEL  
SERVICES IN SELECTED SCHOOL DISTRICTS.**

(L. C. Card No. Mic 60-3429)

Leonard B. Voorhees, Ed.D.  
Michigan State University, 1960

Major Professor: William H. Roe

The primary purpose of this study was to gather data on the organization, administration and operation of pupil

personnel services, as a major adjunct to public school education.

Effort was made (1) to determine the organizational structure affording the best opportunity of service to pupils; (2) to recommend improvements based upon suggestions of administrators and practitioners working in the area; (3) to compile a composite of the information and suggestions, and thus (4) to provide a format for the implementation and improvement of services commonly considered in the pupil personnel area, as well as for the identification of problems in organization and administration.

The study was limited geographically to ninety-three selected school districts in the states of Indiana, Michigan and Ohio, and in scope to a descriptive study, rather than an analytical evaluation, of the data gathered.

For the purpose of the study, a review was made of the literature to establish a background frame of reference of the development of such special services, as well as familiarity with the philosophies and procedures in effect.

To provide experience in research by use of questionnaire and to gather information on an essential factor of the dissertation, a pilot study was executed on certification requirements of pupil personnel or special services personnel in the fifty-seven states and territorial possessions of the United States.

Thereafter, a four-page questionnaire was devised for the primary research, and submitted to the superintendent of each of the selected school districts. The data from the responses was supplemented by personal visitations to many of the school districts.

The major conclusions reached from compilation of the information gathered were:

1. Most of the public school districts in the Tri-State area having a population of twenty-five thousand or more did attempt to coordinate into one department the many special services offered their pupils.

2. The majority opinion favored incorporation of such services into one department.

3. There was indicated a trend toward department organization where no such department was in existence.

4. There was a relationship, but too little uniformity for clarity in communication, in the many titles used in pupil personnel services to designate such department, identify its administrative head and the department personnel, as well as the duties involved.

5. "Department of Pupil Personnel" was the title most often used for the department charged with administration of special services. The director of such department was in the majority of instances directly responsible to the superintendent and classified as an administrative assistant.

6. The size of school enrollment was a determining factor in the organization, administration and operation of a department of pupil personnel.

Recommendations for improvement of pupil personnel services were set forth verbatim from responses to the questionnaire in Chapter IV.

Responsibilities concluded to coordinate well in the area of pupil personnel services were classified and itemized in Chapter V (III).

Four exhibits depicting organizational structures suggested for varying school enrollments were included in Chapter V.

Microfilm \$2.50; Xerox \$8.40. 184 pages.



# THE LEGAL STATUS OF THE DEVELOPMENTAL LEAVE IN THE UNITED STATES

(L. C. Card No. Mic 60-3789)

Paul Wendell Williamson, Ed.D.  
Stanford University, 1960

## Introduction

The development of leaders is a problem of large organizations. A solution widely accepted in private enterprise involves a systematic allocation of resources for the development of leadership talent. A suggestion for the adaptation of this solution to public school administration is made in the Stanford program for leadership development. The Developmental Leave is an integral part of this program.

The Developmental Leave is one year of advanced graduate education for outstanding young administrators. The selected recipient is paid full or partial salary by the employing public school district during leave.

## Resource Data

The four primary sources of legal authority for action by a local board of education are (1) constitutions (both federal and state), (2) state statutes and school codes, (3) rules and regulations of the state boards, and (4) court decisions. Sources 1, 2 and 4 were researched in the Stanford Law Library; source No. 3 was researched by mail to the chief state school officers.

## Constitutions

The Federal Constitution contains no provisions relevant to the legal status of the Developmental Leave.

The constitutional provisions of five states provide ample authority for the local district to grant Development Leaves. The constitutional provisions of one state could be interpreted to eliminate the possibility of any school district being able to grant a Developmental Leave. All other states have constitutional provisions which delegate authority over schools to the legislature or assembly, and in the one case, to a state board of education.

## State Statutes

According to statutory provisions, the Developmental Leave would be legal in thirty-one states. Also, by statutory provisions, the Developmental Leave would be illegal in fourteen states.

Little or no evidence of the legality of the Developmental Leave was found in the statutes of five states.

## State Boards of Education

The local school district's authority to grant Developmental Leaves was neither denied nor permitted by either expressed or implied authority found in the rules and regulations of state boards of education.

The state boards of education in three states would probably authorize local school boards to grant Developmental Leaves.

Three states would probably deny local school boards the authority to grant Developmental Leaves.

Little or no evidence of relevant state board of education rules as to the legality of the Developmental Leave was found in thirty-nine states.

## The Courts

The power of public school districts to spend money for salaries of teachers not specifically engaged in teaching has been subject to varied and changing opinions of the courts.

The amount of discretionary power possessed by the local school board has been the subject of a variety of court interpretations. Generally, the courts will look for reasons to uphold the discretionary action of a local school board if worthy or generally acceptable purposes are involved.

Providing the existing statutes and rules are followed, the courts will not ordinarily interfere with discretionary acts of the local school district.

## Conclusions

The legal status of the Developmental Leave cannot be described as either definite, uniform or consistent. The multiplicity of variables surrounding the granting of a Developmental Leave to a particular person at a particular time, limits, for all practical purposes, our ability to generalize as to its probable legality. Some of these variables are the state constitution, state statutes, rules and regulations of the state boards of education, county and local boards of education, material facts, government legal counsel, court system, etc.

## Recommendations

Seven recommendations are listed as guides for school districts engaged in a Developmental Leave program.

Recommendations for further research are also included.

Microfilm \$2.50; Xerox \$7.60. 162 pages.

# SCHOOL SITE COSTS IN A RAPIDLY EXPANDING SUBURBAN AREA

(L. C. Card No. Mic 60-3790)

Carl Edwin Wilsey, Ed.D.  
Stanford University, 1960

There is general agreement among writers in the field of school planning on the advisability of purchasing school sites in advance of their need for building purposes. Such early acquisition not only assures the availability of more desirable site locations, but is presumed to result in cost savings to the district. However, just how much can be saved, and how far in advance of need sites should be purchased, have not been clearly defined.

It was the purpose of this study (1) to test the hypothesis that cost savings result from early acquisition of school sites, (2) to estimate the dollar savings that may result from early acquisition and (3) to determine how far in advance of need sites should be purchased.

### Procedure

In order to test the hypothesis that net savings result from pre-purchase of school sites, a survey was conducted of all school sites purchased by public school districts in San Mateo County, California, from 1949 to 1959. Utilizing the site cost data thus obtained, a trend analysis was performed and cost indices were developed for land in seven stages of development. An analysis was then made of the net savings that would have resulted from the purchase of an average site from one to ten years in advance of need, considering (1) initial cost savings, (2) the tax loss resulting from removal of the land from the tax rolls, and (3) the interest cost incurred by selling bonds to finance the purchase.

Analysis was also made of the following three variables which presumably affect site costs: (1) population growth, (2) development characteristics of land at the time of purchase, and (3) the number of years in advance of need that sites are purchased.

### Results

During the period under investigation 106 school sites were purchased by the districts included in the survey, at a total cost of \$10,883,292. Individual sites ranged in cost from \$1,016 to \$28,648 per acre, with an average cost of \$7,689 per acre.

The estimated average cost of sites increased from \$3,934 per acre in 1949 to \$10,804 per acre in 1959.

A comparison of initial cost savings with tax loss and interest costs revealed that net cost savings would have been realized if the average site had been purchased two or more years in advance of need. Thus, the hypothesis that cost savings result from early acquisition of school sites was found to be substantially supported in San Mateo County data.

A positive correlation was found to exist between site costs and population growth, and between site costs and the development characteristics of land. A low, negative correlation was found to exist between site costs and the number of years in advance of need that sites were purchased.

### Conclusions

The findings of the study indicate that school sites should be purchased at least two years in advance of need for building purposes, and preferably earlier, depending upon the rate of land development in the area, the school district's ability to project future enrollment, and the district's ability to finance the early purchase of sites. It would seem advisable for districts to borrow money to finance the early purchase of sites, since the initial saving in land cost exceeds the interest cost and tax loss.

The major factors affecting site costs are population growth and the rate of development of land. The fact that a site is purchased in advance of need does not, of itself, insure that cost savings will be realized, since this variable accounts for only a small part of the variation in land prices.

Microfilm \$2.50; Xerox \$5.40. 107 pages.

### EDUCATION, ADULT

#### A PARTICIPATION TRAINING PROGRAM IN A MENTAL HOSPITAL: AN EXPERIMENT IN ADULT EDUCATION.

(L. C. Card No. Mic 60-3007)

John McKinley, Ed.D.  
Indiana University, 1960

Chairman: Dr. Paul Bergevin

### Purpose

The purpose of this study was to determine whether the following needs could be met, among selected adult patients in a mental hospital, through a program of participation training: (1) the need for increased feelings of self-worthiness, (2) the need for increased willingness and ability to accept and help others, and (3) the need for increased willingness and ability to communicate verbally and non-verbally with others.

### Procedure

Twenty one-hour sessions of group discussion were conducted to activate the following conditions: (1) freedom of expression, (2) active voluntary participation, (3) sharing in program development, (4) training in responsibilities of discussion teamwork. The 22 male participants ranged from 60 to 82 years of age. Ten participants, Group O, had diagnosed organic illnesses with mental aberrations; 12 participants, Group F, had diagnosed functional mental illnesses. The major source of data was a rating instrument of 28 criteria, each with a nine-point rating scale. The test for estimating the reliability of the instrument yielded a coefficient of .976. Five raters rated each participant on each of the 28 criteria both before and after the training program. For both groups mean ratings were computed, the t-test of paired differences was applied, and the differences were tested for significance at the five per cent level.

### Findings

Considered as groups the participants in Group O, the participants in Group F, and the participants in the two groups combined made indicated positive gains, in terms of the criteria, that were statistically significant at the five per cent level of significance. In Group O, participants who had the higher mean ratings at the start of the experiment tended to make larger positive indicated gains than did the participants in Group O who had the lower mean ratings at the start of the experiment. In Group F, participants who had the lower mean ratings at the start of the experiment tended to make larger positive indicated gains than did the participants in Group F who had the higher mean ratings at the start of the experiment. In terms of rating scale units, the participants in Group F had larger indicated mean gains per participant than did the participants in Group O.

### Conclusions

The conclusions were provisional because of inadequate control of variables. Hypothesis 1, that all who attended



at least 15 sessions would show increased feelings of self-worthiness, was rejected because only 16 of the 18 eligible participants had positive gains in this area as indicated by the rating data. Hypothesis 2, that all who attended at least 15 sessions would show increased willingness and ability to accept and help others, was rejected because only 15 of the 18 eligible participants had positive gains in this area as indicated by the rating data. Hypothesis 3, that all who attended at least 15 sessions would show increased willingness and ability to communicate verbally and non-verbally with others, was rejected because only 13 of the 18 eligible participants had positive gains in this area as indicated by the rating data. The findings appeared to support a general conclusion that participation training is a potentially effective adult educational technique for rehabilitating selected hospitalized mental patients. Microfilm \$3.65; Xerox \$12.85. 284 pages.

A STUDY OF THE PERSONALITY  
DIFFERENCES BETWEEN A GROUP  
OF WOMEN WHO HAD PARTICIPATED  
IN SEWING CLASSES IN AN ADULT  
EDUCATION PROGRAM AND A GROUP  
OF THEIR FRIENDS AND NEIGHBORS  
WHO HAD NOT PARTICIPATED IN ANY  
ADULT EDUCATION ACTIVITIES

(L. C. Card No. Mic 60-3426)

Marvin Ralph Sitts, Ph.D.  
Michigan State University, 1960

Major Professor: Harold J. Dillon

This study was concerned with the personality differences between a group of women who had participated in sewing classes offered by the Mott Adult Education Program of the Flint Board of Education and a group of their friends and neighbors who had not participated in any adult education activity.

Members of a sample of women who had each taken three classes in sewing were asked to permit interviewers to enter their homes and administer the Sixteen Personality Factor Questionnaire by Cattell, Saunders, and Stice and the "Adult Education Interview Sheet" prepared by this researcher. Each woman selected was asked to invite to her home a friend or neighbor who had never taken an adult education class and who would also be willing to fill in the Sixteen Personality Factor Questionnaire and the "Adult Education Interview Sheet." There were two hundred two women in the two groups.

The scores on the Sixteen Personality Factor Questionnaire indicated a difference between the two groups at the one per cent level on the bright----dull continuum and on the aggressive----mild continuum. The participators were brighter and more aggressive. In other personality factors the participators tended to be more persistent, less polished, more confident, and with a less clear pattern of socially approved behavior.

From the "Adult Education Interview Sheet" it was revealed that the adult education participator had enrolled in more special schools, had a larger income, and belonged to more service clubs and neighborhood clubs. The par-

ticipator attended more activities in school buildings. He voted more frequently in recent elections. He had known about the adult education program longer. In these items the difference between the participator and non-participator was significant at the one per cent level. The participator was older than the non-participator. The difference in age was significant at the five per cent level. In all other of the forty-two questions and observations on the "Adult Education Interview Sheet" there were no differences at any acceptable level.

These findings suggest that since the women participating in these classes have personality factors which are unlike the personality factors of non-participators chosen for this study, these differences should be kept clearly in mind by the adult educator both when he is trying to attract the non-participators to the adult education program and when he is trying to satisfy the needs of the former non-participator once he has enrolled in adult education classes. Recommendations are given in areas where the differences would suggest modifications in the adult education program.

This study represents an effort to measure with care a segment of the adult education population and a segment of the non-participating population. It is hoped that additional similar studies will eventually produce a body of knowledge which will give the adult educator a clear picture of the people with whom he works. This picture will include personality factors as well as factors not usually considered personality factors.

Microfilm \$2.50; Xerox \$8.00. 175 pages.

## EDUCATION, HISTORY

THE NEW YORK STATE STEERING  
COMMITTEE FOR INDUSTRIAL ARTS:  
A STUDY OF ITS ROLE IN RELATION  
TO THE DEVELOPMENT OF INDUSTRIAL  
ARTS EDUCATION IN NEW YORK STATE.

(L. C. Card No. Mic 60-3778)

Robert Sidney Seckendorf, Ed.D.  
New York University, 1960

Chairman: Professor John G. Miller

### Purpose and significance

The purpose of this study was to trace the origin and growth of the New York State Steering Committee for Industrial Arts from its inception in 1934 through 1959. Emphasis was placed upon the Steering Committee's role as it related to the development of industrial arts education in New York State.

A detailed history was developed, reviewing the accomplishments, strengths and problems confronting the association, in order that the future program of the Steering Committee might benefit. The review was conducted in terms of the association's contributions to the changing character of industrial arts education in New York State. The improvement and extension of this educational

program was a major expressed purpose of the Steering Committee. This history might be utilized to promote an improved understanding of the need and purposes for an organization devoted to coordinating the activities of the regional industrial arts teacher clubs in New York State.

#### Procedure and treatment

The study included the development and historical background of industrial arts associations from 1900 to 1934, a detailed description of the proceedings and activities of the Steering Committee from 1934 through 1959 and an examination of the changing character of industrial arts education in New York State during the same period of time. General conclusions were established concerning the relationship of the industrial arts education program to the activities of the Steering Committee as well as the role of the Steering Committee in the improvement and extension of industrial arts education in New York State.

Data were collected consisting of original minutes, reports, correspondence and other documents utilizing the files of the secretary of the association and the Bureau of Industrial Arts Education, New York State Education Department. Additional information was secured from the Education Department's annual reports and published bulletins and monographs. The histories and records of several other New York State teachers associations were utilized where there was a need to establish relationships between the Steering Committee and these organizations.

Relationships were identified concerning the changes in industrial arts education and resultant studies, recommendations and actions of the Steering Committee. In addition, the activities of the association were compared with major changes in the program or policies of industrial arts education in order to identify specific relationships between Steering Committee actions and recommendations and resultant changes in the status or character of industrial arts education. Specific examples were identified in which changes in the industrial arts program were related to the association's studies, recommendations and actions.

#### Conclusions and recommendations

Since 1934 the association expanded its sphere of operation, developed specific purposes and established its structure. It conducted studies and discussions concerning recognized problem areas and changes in industrial arts education as well as the operational necessities of a growing association.

The Steering Committee functions as a delegate assembly consisting of representatives from each of the regional industrial arts teacher clubs in New York State. The continued development of these clubs as well as their increasing number contributed to the association's growing strength and stature.

The established purposes of the Steering Committee include promotion of the policies and program as well as the improvement of industrial arts education in New York State, development of leadership and assistance to other organizations in planning statewide or local professional meetings for industrial arts teachers. The proceedings and activities of the association indicated continued attempts to achieve these purposes.

Major recommendations, based on observable conditions and an analysis of the collected data, include:

The Steering Committee should continue as a coordinating body for the regional industrial arts teacher clubs in New York State. The development of an independent statewide industrial arts teachers association at this time would be an unnecessary additional organization.

Membership should remain on the basis of industrial arts teacher clubs, providing voting privileges to one delegate from each club. Financial support should continue on a per capita basis.

Member clubs should be strengthened, inactive clubs reorganized and, where necessary, regions should be redefined or new clubs organized. Local clubs should be available conveniently for all industrial arts teachers in New York State.

Purposes and goals should be restated and clarified in order to provide an improved understanding of the need for a coordinating body for industrial arts teacher clubs. Microfilm \$5.30; Xerox \$18.70. 414 pages.

#### THE DEVELOPMENT OF THE ENGLISH CURRICULUM IN THE CHICAGO PUBLIC HIGH SCHOOLS FROM 1856 TO 1958

(L. C. Card No. Mic 60-4798)

Donald Edgar Stahl, Ed.D.  
Northwestern University, 1960

This study traces the development of the English curriculum in the Chicago Public High Schools from 1856 to 1958. It includes the results of an investigation of the origin and growth of all the areas which are usually grouped under the heading of high school English, such as composition, grammar, rhetoric, reading, literature, journalism, dramatics, and public speaking, as well as a historical account of the certification of teachers of English.

The primary sources of data included the annual reports and proceedings of the Chicago Board of Education, courses of study, high school yearbooks and handbooks, school directories, student examinations, teacher examinations, textbooks, commencement programs, influential studies and treatises, reports of educational committees, and significant articles from periodicals. Secondary sources of data included works dealing with the evolution of secondary education, the development of grammar, and the history of Chicago.

In order to view the development of the English curriculum in the Chicago Public High Schools in its proper perspective, an account of English education in the United States from its origin to the mid-twentieth century is presented. This survey covers a period of approximately 230 years.

The first public high school in Chicago was established in 1856. In the early curriculums some attention was devoted to the study of rhetoric, etymology, reading, declamation, composition, and English literature, but on the whole English studies were considered subordinate to the other subjects. During the period from 1880 to 1900, more



importance was attached to the subject of English and more time was given to the study of it. Between 1900 and 1937, the Chicago Public High Schools grew rapidly and the English studies underwent considerable modification; it was during this period that elective courses in journalism, dramatics, and public speaking were established and the program in remedial reading was instituted. From 1937 to 1958, more attention was given to improving the curriculum in English, and in 1958 the three-year English requirement for graduation was increased to a four-year requirement.

In general, since 1856 there has been a trend in Chicago to increase the amount of preparation, in terms of college degrees and course credits, required for the certification of teachers of high school English. Also, since the latter nineteenth century, more and more confidence has been placed upon certification examinations, both written and oral, in determining the eligibility of candidates for teaching positions.

Microfilm \$4.00; Xerox \$13.95. 309 pages.

## EDUCATION, PHYSICAL

### THE EFFECTS OF SELECTED INTENSITIES OF ISOMETRIC AND CONCENTRIC-ECCENTRIC EXERCISES OF THE FOREARM FLEXOR MUSCLES ON STRENGTH, ENDURANCE, AND GIRTH.

(L. C. Card No. Mic 60-3905)

John Hubert Dunn, Ph.D.  
University of Illinois, 1960

#### Purpose

The purpose of this study was to investigate the effects of selected intensities of isometric and concentric-eccentric type exercises of the left forearm flexor muscles on the strength, endurance, and girth of the exercised arm, as well as the strength and girth of the right, unexercised arm. As one of several sub-problems, the inter-correlations for all structural and functional measures of the subjects were examined.

#### Methodology

One hundred and twelve male students of Washington State University served as subjects. Initial measurements obtained from the subjects included age, standing height, body weight, somatotype ratings, length of each forearm, girth of each arm, strength score of each forearm flexor muscle group, endurance score of the left forearm flexor muscles, chin-up score, dipping score, and the McCloy pull-up-dip strength score. Strength was measured by means of a specially adapted aircraft tensiometer, while the endurance score represented the distance through which the subject moved an ergographic load equal to 20 per cent of his initial left forearm flexion strength.

On the basis of the initial strength of the left forearm flexor muscles, the subjects were equated into seven

groups. Three groups, termed the concentric-eccentric unit, followed a concentric-eccentric type exercise program, one group each exercising on the ergograph with a weight load equal to one of the following: 20, 30, and 40 per cent of initial left forearm flexion strength. Three groups, termed the isometric unit, followed an isometric type exercise program. All subjects in the isometric unit exercised by holding for six seconds one isometric contraction, one group assigned to each of the following intensities: 1/3, 2/3, and maximum left forearm flexion strength. The seventh group served as a control.

Following the four weeks training program, during which the subjects exercised five days per week, final measurements of girth, strength, and endurance were determined for the subjects in all seven groups.

Statistical treatment of the data included the use of the "t" test, the analysis of variance, Duncan's Multiple Range Test, and the product-moment coefficient of correlation.

#### Findings

1. All groups, with the exception of the control, made significant gains in the strength of the left forearm flexor muscles. Although a significant difference was found between the mean gains of each of the six exercise groups and the control group, no real differences were found between the mean gains of the six exercise groups.

2. All three groups in the concentric-eccentric unit improved significantly, at the 1 per cent level, in the strength of the right forearm flexor muscles. Neither the control group, nor any group in the isometric unit improved to the degree necessary to meet the requirements for statistical significance.

3. Four of the exercise groups gained significantly, at the 1 per cent level, in left arm girth. These included all groups in the concentric-eccentric unit and the maximum isometric group. No real differences were found between the means of the four groups.

4. No groups increased significantly in right arm girth.

5. An increase in the endurance of the left forearm flexor muscles, significant at the 1 per cent level, was made by each of four groups, namely, the three groups in the concentric-eccentric unit and the 2/3 maximum isometric group.

6. A negative correlation (-.420), significant at the 1 per cent level, was found between the strength and endurance scores of the left forearm flexor muscles.

7. With one exception, no significant correlations were found to indicate that changes in strength, endurance, and girth varied alike. The increases in right and left arm girths correlated .591 which is significant at the 1 per cent level.

Microfilm \$2.50; Xerox \$6.80. 142 pages.

**A SURVEY OF RECRUITMENT AND  
SELECTION PRACTICES AND  
PROCEDURES OF WOMEN PHYSICAL  
EDUCATORS IN COLLEGES AND UNIVERSITIES**

(L. C. Card No. Mic 60-3871)

LaVernia Mae Jorgensen, P.E.D.  
Indiana University, 1960

Chairman: Dr. Marjorie Phillips

**Purpose**

The purpose of this research was to survey and study the present practices for recruiting and selecting women physical educators. In the light of the short supply of women physical educators, it was believed that the techniques in recruitment and selection which this study might reveal to be effective, would be of value to women's physical education departments in developing and improving their programs.

**Procedure**

The survey was conducted by means of a questionnaire which was sent to the 460 institutions offering a major in physical education for women in the United States. Respondents were asked to rate their degree of success with recruitment procedures.

The data were arranged into tables for analysis and interpretation and the number and per cent using a procedure were recorded on the basis of (1) the total population which recruits or selects women physical education majors, (2) the response of each district as defined by the American Association for Health, Physical Education, and Recreation, (3) institutional control--public or private, and (4) type of institution--coeducational or for women only. Ratings of success for recruitment procedures were also recorded by number and per cent on the basis of the same four categories.

**Summary of Major Findings**

Of the 280 institutions which responded 85 per cent recruit physical education majors and experience fairly good success with their programs, and over 94 per cent have selection programs.

The following recruitment procedures were rated as good or better than good practices by the respondents:

Offer scholarships to prospective women majors; Enlist the aid of former physical education graduates to recruit major candidates; Provide written information for prospective majors; Provide general as well as specific scholarships for prospective majors; Cooperate with the guidance department; Keep in touch with physical education graduates through an annual letter, through a periodic newsletter from the department, and/or through contact at professional conferences; Sponsor play days, sports clinics, demonstrations, dance clinics, and/or officiating clinics for high school or college students; Publish career booklets, brochures, and/or bulletins as written information for prospective majors; Administer vocational or teaching aptitude tests, begin a file on the prospective major, and/or counsel with prospective majors before actual entrance

into the physical education program; Use slides on activities as an audio-visual aid; Use undergraduate women physical education majors to contact prospective majors; Use pre-screening procedures with prospective majors; Keep the high school physical education teacher informed of the supply-and-demand picture of women physical educators through an annual letter, at the time of her visit on campus, and/or during personal visits of representatives of the department to the high school; Recruit physical education majors through the physical education department; Recruit physical education majors preferably during their first semester in college.

All of the following selection practices were used by at least 50 per cent of the respondents which select women physical education majors:

Require a physical education candidate to be a graduate of an accredited secondary school or its equivalent; Require strengthening through counseling and guidance procedures of weak candidates if accepted as majors; Require a candidate to have personal interviews with the staff after acceptance as a major; Assign a faculty member to each major; Keep a cumulative record of each major student; Have faculty discussions concerning women students during their years as majors; Require regular group meetings of women majors; Require a specific number of high school credits for admission to the physical education program; Require the candidate's high school transcript; Require the candidate to have good health; Require women candidates to take tests of intellectual ability before admission to the physical education program.

Microfilm \$7.05; Xeros \$25.20. 556 pages.

**TEACHER LIABILITY IN PHYSICAL  
EDUCATION IN CALIFORNIA**

(L. C. Card No. Mic 60-3784)

Dan Edgar Lacy, Ed.D.  
Stanford University, 1960

The problem of this study was to identify and discuss rules of law which relate to the legal liability of teachers of physical education and coaches of interscholastic athletic teams while such personnel are acting within the scope of their employment. The study was delimited to include only teaching personnel of the public secondary schools which are governed by the Education Code of California.

The historical method of research was emphasized in gathering data for the study. The following outlined method of search was used.

1. Analysis of the Problem. Separation into different aspects involved.
2. Preliminary Review of the Subject Matter where needed for orientation.
3. Search of the Statutes and Administrative Regulations involved in the problem under investigation.



4. Search for Cases in Point. The indexes of the annotated Code volumes and of the "Reporter Series" were used to find the court cases dealing with teacher liability.
5. Search of the Legal Treatises and Publications. From these was obtained an analysis of the matter under investigation.
6. Search of Miscellaneous Material. From the loose-leaf services, advance sheets, and other studies for the latest material and theoretical discussions of the points of law involved.
7. Appraising the Authorities Found. Primary authority is the authority found in direct legislation and judicial decision. Secondary authority is found in opinions and assertions of legal advisors, judges, and legal writers.

Conclusions were validated by submitting the material to legal personnel for criticisms concerning the procedure, thoroughness of research methods, and accuracy of the interpretations.

Reliability was obtained by submitting the data and conclusions to attorneys who gave their time to analysis and critical suggestions.

Objectivity was increased by careful checking and re-checking of the proposed interpretations with the interpretations of qualified researchers and law personnel.

The general rules of law or conclusions and suggestions for the use of physical educators and administrators are listed in the Appendix for ease of reference.

The following selected conclusions or general rules resulted from the study:

1. All pupils enrolled in the elementary, junior, or senior high schools of California, except those excused by law, must take the prescribed courses in physical education.
2. The governing board of each school district should prescribe the courses of study in physical education and prepare and distribute to all physical educators within the district a syllabus containing the course content of the physical education curriculum.
3. Teachers are personally liable for injuries to pupils arising from their own individual negligence.
4. The school district assumes vicariously the liability for damages arising from the negligence of its employees or agents while performing their regular assigned duties.
5. An instructor is guilty of negligence where an injury occurs to a member of his class through negligent, improper, or inadequate supervision.
6. The school district is deemed negligent if an injury occurs to a student through supervision by unqualified personnel.
7. The physical educator may be deemed negligent if a student is injured while participating in an inherently dangerous activity or an activity that is beyond his physical, mental or emotional capacities.
8. The physical educator is negligent if an injury occurs to a member of his class through the use of dangerous or defective equipment, or the use of an

unsafe playing area even though no other equipment or playing area is available.

9. A physical educator may be deemed negligent if he fails to render first aid to an injured member of his class where medical assistance is not immediately available.
10. The physical educator should not recommend the use of "pep-up pills," "energizers," stimulants, or dietary programs which may be injurious to the health of his students. Only a qualified physician may prescribe.

Microfilm \$2.50; Xerox \$8.40. 185 pages.

## EDUCATION, PSYCHOLOGY

### A STUDY OF PARENTS' PERCEPTIONS OF THE ROLE OF SCHOOL COUNSELORS IN A SELECTED COMMUNITY

(L. C. Card No. Mic 60-3765)

Harry Benjamin Bergstein, Ed.D.  
New York University, 1960

Chairman: Professor Claude W. Grant

#### Purpose

This study was concerned with determining how parents in one community perceive the role of counselors in the secondary schools. The specific role of the counselor that was considered was his helpfulness to children in the problem areas of educational planning, vocational planning, and personal-emotional-social adjustment. The answer to the problem was sought by interviewing fathers and mothers of children in grades six, eight, ten, and twelve.

#### Hypotheses

The hypotheses underlying this study were, in summary, as follows: parents of children in higher grade levels have a greater degree of agreement in their perceptions of the role of counselors than do the parents of children in lower grade levels; parents of children in higher grade levels perceive counselors to be more helpful than do parents of children in lower grade levels; parents of sixth-grade children perceive school counselors to be more helpful than people who are of average help, less helpful than best family friends, and less helpful than school principals; parents of secondary-school pupils perceive counselors to be more helpful than best family friends and more helpful than school principals; and parents at all four grade levels perceive counselors to be more helpful with educational and vocational problems than with personal-emotional-social problems.

#### Procedure

Pupils from each of the grades, six, eight, ten, and twelve, who had not had older siblings in secondary school, were matched on the variables of general school performance,

family's socio-economic standing, and intelligence quotient. Fifty of the matched sets were drawn at random, the parents of these pupils comprising the population of the study.

Each parent made free-response nominations in reply to the question of who would be of help to a child at each of five gradations of helpfulness. This was done for each of eight problems. For each problem, the parent's nominations constituted anchoring points of a scale on which the parent then rated, by man-to-man comparison, his best family friend, the school principal, and the school counselor. The scaling procedures were adapted from the Gardner and Thompson Social-Relations Scales. Parents' spontaneous remarks about the role of school counselors were also noted.

In evaluating the significance of differences in statistical measures between groups, the following methods were employed: for comparing proportions - the ratio between the difference in proportions and the standard error of difference; for comparing variances - Snedecor's *F* test; and for comparing means - analysis of variance and Fisher's "*t*" test. Differences at the .05 level were considered significant and differences at the .01 level were considered very significant.

### Conclusions

The conclusions, based on the limitations of the study and on the results obtained, were, in summary, as follows:

The degree of agreement shown by parents, in their perceptions of the role of school counselors, does not follow a distinguishable pattern among the four grade levels, six, eight, ten, and twelve.

Parents of sixth-grade pupils have high expectations of the role of secondary-school counselors. The perceptions that parents of secondary-school pupils have of the role of school counselors do not vary significantly from these expectations.

Parents of sixth-grade children perceive school counselors to be more helpful than people who are of average help, more helpful than best family friends, and more helpful than school principals.

Parents of secondary-school children perceive school counselors to be more helpful than best family friends and more helpful than school principals.

Parents at all four grade levels perceive school counselors to be more helpful with educational and vocational problems than with personal-emotional-social problems.

Microfilm \$2.70; Xerox \$9.45. 208 pages.

### EFFECT OF SOCIAL CLIMATE ON THE LEARNING OF MATHEMATICS: THE EFFECT DOMINATIVE AND INTEGRATIVE CLASSROOM CLIMATES HAVE ON THE LEARNING OF MATHEMATICS BY THIRD GRADE ELEMENTARY SCHOOL CHILDREN.

(L. C. Card No. Mic 60-3745)

Fred Guggenheim, Ph.D.  
New York University, 1960

Supervisor: Professor Dan Dodson

The purpose of this study was to investigate the influence of dominative and integrative classroom climates on the learning of mathematics by third grade children. Practical limitations made it necessary to use an indirect method of evaluating and selecting teachers for the study. A high correlation between teacher behavior and classroom climate was assumed. The Wrightstone Teacher-Pupil Rapport Scale was used to select the dominative and integrative classes. The reliability of the selection of the classes for inclusion in the study was established by having two persons independently rate the classroom climate of twenty classes. A rank difference coefficient of correlation of .83 was obtained.

The procedure involved determining the initial mathematics achievement level of the pupils at the beginning of the school year, matching the groups in mathematical achievement, and re-testing the same groups after a year of instruction in the different climates. The criterion used for evaluating the effectiveness of climate was the scores attained in re-testing. The New York Inventory of Mathematical Concepts, Grade 2, was used in the initial testing and matching of groups. The Grade 3 version was used in the final evaluation. The pupils were also matched in IQ scores using the Otis Quick-Scoring Mental Ability Tests: New Edition, Alpha Short Form.

The schools were selected from a list of all public schools designated as "average" by the Elementary Division of The Board of Education of the City of New York. Eleven schools were chosen, from which the twenty-two classes were drawn. Fifty third grade classes in these eleven schools were evaluated with the Wrightstone Scale and ranked in order of rating. The eleven highest (Integrative) and eleven lowest (Dominative) classes were selected for the experimental and control groups. The significance of the difference between the two groups in classroom climate was established by the *t* test ( $t = 8.63$ ).

In order to achieve greater accuracy in the evaluation and to discover if there were any differential effects of climate on level of achievement, the pupils in each group were subdivided into three levels of initial mathematics achievement. The selection of level was made by dividing the total pupil population of this study into three equal parts and designating them as representing high, average, and low levels of mathematics achievement in relation to the distribution of the whole group.

The evaluation of the experiment utilized a treatment by levels design in which the two climates were administered to two groups. The final mathematics achievement scores for the pupils were tabulated in a double entry table of rows of levels, columns of climate, and cells to the subgroups within the three levels. An analysis of variance technique was used to evaluate the problem. The total sum



of squares was analyzed into four parts. The total sum of squares consisted of a sum of squares for climate, a sum of squares for levels of achievement, a sum of squares for climate by levels of achievement, and a sum of squares for within subgroups.

The hypotheses of the research were tested by the F ratio. An F ratio of 1.55 was obtained for the difference in mathematics achievement. From a table of F values it was found that the obtained F was not significant. Since the mean square for interaction was less than the within subgroups mean square, no further F ratios were computed. On the basis of the obtained data it was concluded that classroom climate, within the specified limits of this study, does not significantly affect the learning of mathematics by third grade elementary school children.

Microfilm \$2.50; Xerox \$7.20. 153 pages.

#### A STUDY OF THE STUDENT PERSONNEL SERVICES AT MICHIGAN COLLEGE OF MINING AND TECHNOLOGY

(L. C. Card No. Mic 60-3414)

Ormsby L. Harry, Ed.D.  
Michigan State University, 1960

Major Professor: Walter F. Johnson

#### The Problem

The purpose of this study was to investigate the student personnel program at Michigan College of Mining and Technology through an examination of the problems of students as they perceived them, and the means by which they received assistance in resolving them. The study also investigated faculty awareness of the kinds of problems that students face, as well as faculty knowledge of available student personnel services where students could be referred.

#### Methodology

The instruments administered to the student sample included the Mooney Problem Check List and a Student Questionnaire. The faculty perceptions of (1) available student personnel services, and (2) problems of students, were ascertained by their responses to two faculty questionnaires. In addition three student personnel consultants were asked to react to the existing student personnel services in terms of strengths and weaknesses.

The statistical procedures used for analyzing the data collected, included Chi-square Median Test, Spearman Rank Correlation Coefficient, and Kendall Coefficient of Concordance.

#### Findings

The principle findings of the study:

1. Significant differences were found between faculty and engineering science seniors of where students may obtain help with problems of "Finances, Living Conditions, and Employment." Similar differences were found between faculty and mineral industries students in perceptions of

sources of help with problems relating to "Social and Recreational Activities."

2. Single male students in all sample groups studied showed no significant differences with respect to number and type of problems underlined and total problems circled.

3. Married students indicated a statistically significantly greater concern with problems relating to "Finances, Living Conditions, and Employment" than did single students.

4. Differences between students' perceptions of their problems and faculty perceptions of the students' problems were not statistically significant.

5. There were no differences between Michigan College of Mining and Technology students' perception of their problems from the perceptions of students enrolled in non-technical curricula at two other institutions.

Microfilm \$2.50; Xerox \$7.00. 149 pages.

#### A MULTIVARIATE ANALYSIS OF THE RELATIONSHIP OF ACADEMIC APTITUDE, SOCIAL BACKGROUND, ATTITUDES AND VALUES TO COLLEGIATE PERSISTENCE.

(L. C. Card No. Mic 60-3416)

Stanley Oliver Ikenberry, Ph.D.  
Michigan State University, 1960

Major Professor: William W. Farquhar

The purpose of this investigation was to contribute to the knowledge about students who withdraw from college prior to the completion of the freshman year. In addition to differentiating between students who remained and students who withdrew from college, the study was designed to differentiate between withdrawals of above and below average first term achievement, and between male and female withdrawals.

The population of the study consisted of full-time, native born, new entering freshmen at Michigan State University, fall, 1958. From the 2,746 students in the population, the 303 students who withdrew prior to the completion of the 1958-59 academic year formed the sample of "withdrawals" for the study. A random sample of 250 students was drawn from the remainder of the population for the purposes of comparison, and formed the "enrollee" sample for the study. A further classification by first term achievement and sex was made in both the withdrawal and enrollee samples. This classification scheme yielded ten groups.

The following measures were used in the study: (1) The College Qualification Test; (2) Test of Critical Thinking, Form G; (3) Michigan State University Reading Test; (4) The Inventory of Beliefs, Form I; (5) Rokeach's Dogmatism Scale, Form E; (6) The Differential Values Inventory; and (7) A social status index. The first three measures dealt with various aspects of intellectual ability; the fourth and fifth were measures of attitudes of stereotypy and dogmatism; the sixth was a measure of traditional Protestant ethic values; and the final index was a combination of the social background variables of father's and mother's educational level and father's occupational prestige. All testing was completed during the first week of the fall term, 1958.

Multiple discriminant analysis, a statistical technique of defining linear combinations of variables which maximize differences among groups and minimize differences within groups, was used to analyze the data. The first linear combination, or discriminant function, maximizes the dispersion among groups, and subsequent functions maximize dispersion among groups with the effects of previous functions removed.

The analysis of data yielded three significant discriminant functions and thus the null hypothesis, "There is no difference in intellectual ability, social background, attitudes, and values among groups of students classified by collegiate persistence, first term grade point average, and sex," was rejected. The first function accounted for over 60 per cent of the variance as defined by the variables, and was primarily an intellectual function. The second function accounted for approximately 25 per cent of the total variance and was interpreted as a social-cultural function, maximizing sex differences. The third function accounted for about 5 per cent of the total variance and was interpreted to be a social background function, with the usual correlates of intelligence and sex removed.

Within achievement and sex categories enrollees were consistently higher than withdrawals on the intellectual function. This function, however, discriminated primarily between above and below average achievement groups. When collegiate persistence groups were classified by achievement level and sex, withdrawals were heterogeneous in intellectual ability.

Within achievement and sex groups, enrollees were higher on the second, social-cultural, function than withdrawals. The main discrimination of the second function was, however, between sex groups, females being higher than males. The third function, a social background function with sex and ability factors removed, discriminated between students who withdrew from college and students who remained enrolled, regardless of achievement level or sex. This function may have represented an indirect measure of social-psychological motivation and other circumstantial factors resultant from different social backgrounds or environments and related to college attendance and persistence.

Microfilm \$2.50; Xerox \$6.80. 142 pages.

#### THE EFFECT OF INSTRUCTOR-STUDENT VALUE DISCREPANCY ON THE ATTITUDE CHANGE OF PROSPECTIVE TEACHERS

(L. C. Card No. Mic 60-3425)

Thomas Clinton Seward, Ph.D.  
Michigan State University, 1960

Major Professor: William W. Farquhar

One common objective among institutions of higher education today, concerns the development and change of student attitudes. Realistic considerations regarding the extent of the college influence on student attitudes have evoked considerable controversy. This thesis attempts an answer to the more basic problem of how student attitudes are influenced through the educational experience. A theory of attitude change is advanced which involves the following

primary considerations: (1) Personality is an organized, consistent structure of values which are formed early in life. (2) These basic values direct behavior toward the maintenance of the self in a consistent manner. (3) The individual tends to reject those experiences which he perceives as threatening to his basic value structure. (4) The assimilation of additional beliefs, attitudes and values is a continuous process which varies widely among individuals, even though they may embrace similar value structures.

In order to test the above theory it was hypothesized that students in beginning education classes would change their attitudes toward teaching in direct proportion to the amount of value agreement that existed between themselves and their instructor. The students (185) of ten such classes at Michigan State University were administered pre-post-tests of teacher attitudes using the Minnesota Teacher Attitude Inventory (MTAI). Both instructors and students were also administered the Differential Values Inventory (Prince, University of Chicago, doctoral dissertation, 1957) to determine the extent of value agreement. The typical student in the sample was a sophomore female majoring in education.

Four variables believed to affect the degree of attitude change were controlled through application of the treatments by levels design (Lindquist, Chapter V). The variables include: 1) the effects of the students' initial agreement with the attitude, 2) the effects of the students' perception of the extent that their instructor agrees with the MTAI criteria, 3) the effects of the instructors' expressed agreement or disagreement with the MTAI criteria, and 4) the effects of the students' previous involvement with teacher attitudes. Identification of the variables necessitated two additional testings--the administration of 1) the MTAI to the instructors and 2) an instrument designed to obtain student ratings of their instructors on the MTAI criteria; the age and grades of the students were used as an estimate of previous involvement. High, medium and low degrees of instructor-student value discrepancy constituted the three treatments; three levels of each of the four variables constituted the levels in four separate analyses of variance.

Application of the analysis of variance technique resulted in the acceptance of all null hypotheses. It is concluded that: There are no significant differences among the attitude changes of students whose value discrepancy with their instructor is high, medium or low.

The major limitations of this study concern the following factors: 1) the absence of random assignment, 2) excessive sample losses about which little is known, 3) inadequate control of the instructor influence toward attitude change, and 4) an inadequate measure of basic values as defined in this thesis. These limitations emphasize the need for additional research regarding the effect of value conflicts on the attitude change of students.

Microfilm \$2.50; Xerox \$7.00. 150 pages.



AN EVALUATION OF THE RELATIONSHIP  
BETWEEN ATTITUDES TOWARD SELF  
AND ATTITUDES TOWARD A VOCATIONAL  
HIGH SCHOOL

(L. C. Card No. Mic 60-3779)

Dorothy Silverman, Ed.D.  
New York University, 1960

Supervisor: Professor Dan Dodson

The purpose of this study is to evaluate the relationship between attitudes toward self and attitudes toward a vocational high school. It had been hypothesized that because the self is constrained to perpetuate and enhance itself, there would be an inverse relationship between attitudes toward self and attitudes toward a vocational high school--the higher the level of self-acceptance, the lower the level of vocational school acceptance, and conversely, the lower the level of self-acceptance, the higher the acceptance of a vocational high school. Substantiation of this hypothesis would mean that the trade high school, because of its low status, can neither support healthy self-esteem nor correct poor self-esteem--each a prerequisite for motivated learning.

To obtain data for a test of this hypothesis, two instruments were employed. A modified form of Bills' Index of Adjustment and Values (high school form) was used to measure attitudes toward self. The revisions were made by the writer to achieve simplification and clarification of the form for vocational students. A questionnaire of 86 items, each with 5 options, was devised by the writer to assess attitudes toward a vocational high school. Both instruments are scored by the method of summated ratings. Participating in the study were 242 sophomores and juniors of a New York City vocational high school who are following a trade course and who have a minimal reading level of fifth grade.

Analysis of the data leads to these major conclusions:

1. The boys in this vocational high school are similar to other high school populations in their attitudes toward themselves. There is also a slight tendency for the increment of age to yield more acceptable self-attitudes ( $r = .160$ ;  $p = .05$ ).
2. The boys show general approbation for the school and see much similarity between it and the academic high school, but there is a fairly consistent advantage given to the latter whenever a difference is noted. They are strongly inclined to believe that their school is relegated to second place by academic students, by teachers, school officials, and employers. They, too, reflect a conviction in the superiority of the academic high school.
3. There is a significant ( $p = .01$ ) negative correlation between intelligence and attitude toward a vocational high school ( $r = -.239$ ) which reveals a tendency for the brighter student to dislike the trade school.
4. The Pearson product moment correlation between attitudes toward self and attitudes toward a vocational high school is .267 which is positive and significant at the .01 level. The hypothesis that there would be an inverse relationship between the two variables is not supported.

Consideration was given to a number of factors which may have predisposed the variables to follow similar rather than divergent paths. In the first place, the effects of school status on the self-image may be more telling in the graduating classes of the lower schools when the selection of a secondary school is to be made than in the high school itself. Secondly, the reasons for choosing a vocational high school may supersede or minimize any concern for its status. Also, the significance of the school as a status-giving object may vary with individual students.

An additional possibility relates to the dynamics of the self-structure whereby the admission of a new percept entails a readjustment of the self-configuration to accommodate it and a modification of the percept to fit the total picture by taking on the dominant coloration of the self. Finally, the greater closeness of self-attitudes with age and of school attitudes with intelligence suggests that hidden subsidiary and gravitating variables may control the coordination of the self-system.

Microfilm \$2.75; Xerox \$9.45. 209 pages.

EDUCATION, RELIGION

A HISTORICAL STUDY OF THE ORIGIN  
AND DEVELOPMENT OF THE SEABURY  
SERIES OF THE PROTESTANT  
EPISCOPAL CHURCH

(L. C. Card No. Mic 60-3737)

Dorothy Lillian Braun, Ph.D.  
New York University, 1960

Chairman: Professor Lee A. Belford

Commensurate with the rising interest in curriculum, both secular and religious, in 1945 the Protestant Episcopal Church, not having its own curriculum, requested that such materials be prepared. By 1957 its Department of Christian Education had completed a closely-graded, eleven-year curriculum, from pre-school through grade nine. To religious educators, particularly curriculum workers, a knowledge of the processes used by the Episcopal Church should prove valuable. This study, therefore, has endeavored to trace historically the methods used and procedures developed, noting the Department's efforts to achieve a synthesis of the life-centered and content-centered principles of curricular theory.

Minutes of quarterly meetings of the National Council of the Episcopal Church, the Department of Christian Education, and its Divisions provided the skeletal framework of the study. This was supplemented by records, reports, and correspondence in the files of the Department at Greenwich, Connecticut, and information from fifty persons--present and past Department officers, National Council and coopted members, consultants and staff members--interviewed during the course of the study. Data were collated and organized chronologically, then charted under various headings, to clarify the developmental process by years and subject.

Calling upon leaders in every phase of the church's

educational program as well as upon secular educators, the Department developed a dynamic approach to curriculum which drew upon insights from the fields of child development, educational psychology, sociology, and group dynamics, as well as theology and related subjects. The staff endeavored to write materials that would take into consideration the existential situation at each age level and enable teachers to help pupils see the relevance of the Christian gospel to present life problems. Through an extensive program of study and experimentation, the Department developed courses requiring the teacher to begin with pupils' needs rather than with content. Instead of a series of lesson plans, each manual is a resource book which includes a "profile" of the age level, excerpts from class sessions illustrating teaching methods, numerous resource materials, and bibliography.

Convinced that new materials alone would not solve the church's problems, the Department undertook a large-scale training program for clergy and laity. Through mobile teams, nationwide summer conferences, year-round weekend retreats for lay leaders, annual visits with diocesan departments of Christian education, twelve-day group life laboratories for clergy, and an extensive teacher training program, the Department emphasized that every experience of life was a theological experience, and consequently the atmosphere of home and parish were of greater importance than a new set of teaching materials. (Thus, the staff emphasized the need for adult study classes and parent classes, and church family worship services.) They sought to develop concerned groups within each parish, through which the total life and program of the parish would be revitalized and from which would come leaders and teachers with a vital personal faith, basic for use of the new curriculum.

Content would come, not only from the teachers' manuals, but from the Church's Teaching Series, six volumes setting forth the teachings and work of the Episcopal Church, the result of corporate scholarship by an Authors' Committee representing differing churchmanship traditions.

Further results of the program include a church publishing house; *Christian Education FINDINGS*, a magazine for clergy, parish leaders and teachers; and evaluative devices for appraising and revising the curriculum. During this twelve-year period the increase in church membership was more than three times as great as in the preceding twelve years; confirmations increased by almost 50,000, compared with a decrease of 27; and church school staffs and pupils doubled, compared with a loss of 23 per cent.

Microfilm \$4.75; Xerox \$16.90. 371 pages.

## EDUCATION, TEACHER TRAINING

### A STUDY OF THE SUBJECT CONTENT AND THE TEACHING PROCEDURES USED IN THE UNIFIED STUDIES CLASSES IN THE SHAWNEE-MISSION JUNIOR HIGH SCHOOLS

(L. C. Card No. Mic 60-4321)

Ralph Evan Chalender, Ed.D.  
University of Kansas, 1960

1. Statement of the Problem. In 1955, the Shawnee-Mission Schools, located in Northeast Johnson County, Kansas, opened four junior high schools. Unified Studies, a block-time or core type class, was put into operation as a required course in all three grades. Prior to this investigation no study of the subject content or the teaching procedures used in the Unified Studies classes had been made. The present investigation was designed to study the subject content and teaching procedures used by experienced Unified Studies teachers in each of the junior high schools.

2. Procedure. Fifty-one teachers who had taught one or more years in the system were interviewed to secure information regarding the teaching of Unified Studies. The interviews were based on structured questions which were designed to secure information about subject content and the types of procedures used in teaching the various phases of the course. Each interview was tape recorded.

3. Findings. In general teachers used some form of committee work during the year. Teachers usually select committees according to the pupils' interests. The methods used in getting all pupils to work in committees differed. The most essential factor reported was the importance of knowing something about each individual's needs, interests, personality, and ability to get along with others.

All classes have a weekly library period. Ninety-three per cent of the teachers found the librarian to be of great help in locating books and assisting in finding resource materials.

The experiences which pupils have working together were found to be most helpful in the development of oral communication skills.

All teachers interviewed reported that they found many opportunities in all the units of work to encourage creative writing.

In general teachers reported that they did not find it difficult to teach the mechanics of expression in relation to the units of work. Several of the teachers, however, digressed from the Unified Studies approach and were teaching grammar as a separate subject. There was some uniformity in the methods used in teaching the parts of speech, capitalization, punctuation, and spelling.

Teachers reported that a wide and good selection of books and equipment were provided for the teaching of geographical concepts.

Social skills, attitudes, interests, work study habits, appreciations and self-evaluation techniques are some of the important areas that were mentioned as being parts of the guidance provided for pupils in the Unified Studies classes.

Many of the teachers reported that the methods required for teaching Unified Studies successfully were more difficult than the traditional method, but that it was more challenging and rewarding. The most frequently mentioned



values of Unified Studies included the integration and correlation of materials; development of better work study skills; the development and furthering of democratic procedures; the development of more acceptable social habits; the opportunity for group and individual guidance; the furthering of individual interests through the wide variety of subject matter; and the opportunity to develop critical thinking.

4. **Conclusions.** Since the introduction of Unified Studies in the schools, there has been a general improvement in teaching procedures. Teachers tend to correlate the material better, make more and better use of democratic procedures, are more flexible, are more at ease, and maintain a more relaxed atmosphere in their classes. Teachers consider the first year as the most difficult in teaching Unified Studies and recommend that more opportunities be made available to beginning teachers for preparation in teaching in this type of program.

Microfilm \$2.50; Xerox \$7.80. 167 pages.

#### CONTEMPORARY TEACHER EDUCATION IN FRANCE AND BELGIUM

(L. C. Card No. Mic 60-4496)

Patricia Simonet Charlier, Ph.D.  
University of Minnesota, 1960

The present study has sought to describe patterns of teacher training which have existed in France and Belgium. Background information has been supplied about present systems of education and their historic antecedents which helps to explain educational practices and reforms.

History and tradition have been especially influential in their effects on teacher training programs in France. The idea that a high level of general culture must reflect the traditional and classical fields has helped to shape the pattern of general education required of all teachers in France. To a certain extent this is also true in Belgium. Both countries retain from the Napoleonic regime a centralized form of educational organization and administration. Reforms have evolved slowly in both countries, but major changes reflect the more technological society which has emerged since World War II. The separate growth of the various levels and types of education--primary, secondary, technical and higher education--has been accompanied by separate programs of teacher training for each level and type.

In France teachers for primary schools are trained in state primary normal schools. Recent reforms aimed at raising the quality of general education have included in the normal school curriculum preparation for the baccalaureate, the secondary school degree which admits students to the universities. Professional studies in education, methods and psychology and practice teaching are provided in one or two post-baccalaureate years.

Competitive examinations control entrance to normal schools and to programs for secondary school teacher training at the university level. Students who qualify receive almost complete state subsidization of tuition and living expenses. State quotas for student teachers in the various levels and subject areas are established on the basis of projected openings on school staffs and current

national budgetary limits. Student teachers who benefit from these grants are expected to teach for ten years in the public schools. Lack of qualified teachers has forced temporary employment of partially-qualified personnel.

As the pupil age increases, the amount of academic preparation required of the teacher also increases; the amount of required professional training decreases. The secondary school teacher of academic subjects in France must have at least the licence, the degree granted after three or four years of university studies. Students are supervised during one year of practice teaching and conferences on methodology and educational psychology by experienced secondary school teachers directed by the Centres Pédagogiques Régionaux in each university town. The student qualifies for the Certificat d'Aptitude au Professorat du Second Degré (certificate of aptitude for teaching at the secondary level) by practical examinations to determine teaching ability after the year of training.

Teachers for technical schools receive training in the technical schools. Their professional education is similarly examined for the Certificat d'Aptitude au Professorat de l'Enseignement Technique.

Teacher training programs in Belgium also provide differing patterns for teachers of various educational institutions. A four-year plan of studies at the secondary level (without university-admitting degree) prepares student teachers of ages fifteen to nineteen for pre-primary schools. Primary normal schools offer a four-year curriculum leading to both the diploma in humanities of the secondary schools and to certification as primary school teachers. Median normal schools offer two years of academic and professional studies to holders of the diploma in humanities and prepare teachers for classrooms of the lower secondary cycle. Teachers of the final three years of secondary schools must be university graduates who receive limited professional training.

Belgium, under the most recent reforms, no longer requires entrance examinations for programs of teacher training. Qualified students are eligible for any level of studies and must seek positions individually.

Microfilm \$3.95; Xerox \$13.75. 305 pages.

#### A STUDY OF OPINIONS AND REACTIONS OF PUPILS CONCERNING CERTAIN ASPECTS OF THE UNIFIED STUDIES PROGRAM OF THE JUNIOR HIGH SCHOOLS IN THE SHAWNEE-MISSION HIGH SCHOOL DISTRICT

(L. C. Card No. Mic 60-4322)

Wayne D. Craven, Ed.D.  
University of Kansas, 1960

1. **Statement of the Problem.** Authorization by the Board of Education in 1953 permitted the Superintendent of Schools in the Shawnee-Mission District, Northeast Johnson County, Kansas, to provide a unified studies type of curriculum for the junior high schools. No survey of pupil opinion and reaction to the unified studies program had been reported. The present study was made to determine the opinions and reactions of selected pupils from the six junior high schools in the Shawnee-Mission District,

concerning certain aspects of the unified studies program in which they were enrolled.

2. Procedure. This investigation was conducted by collecting data through the use of a pupil questionnaire administered to 1520 pupils in the Shawnee-Mission Junior High Schools. The questionnaire consisted of seventy items describing varied activities which pupils might do in a unified studies class. In the first part of the questionnaire the pupils were asked to indicate how important they felt the activity was, by checking one of the following:

1. Of little importance, 2. Fairly important, 3. Very important. In the second part of the questionnaire, the pupils were asked to check how often they performed these same activities by marking one of the following: 1. Very little, 2. Quite a bit, 3. A great deal. Upon completion of the questionnaires, they were taken to the Statistical Service at the University of Kansas to be coded on I B M cards. Then the results were tabulated.

3. Findings. The tabulation of responses received from the pupils showed that in all of the seventy items on the questionnaire, a higher percentage marked "very important" and "fairly important" than marked "quite a bit" and "a great deal." In many of the items there were some differences in responses among the grades. These differences were attributed to the fact that the different units taught in the three grade levels emphasize different items.

In all situations where there was a marked difference in the responses among the grade levels, the grade that marked the greatest percentage of frequency of the activity also indicated the greatest importance.

In no items did the majority of pupils indicate that they thought the activity was of little importance.

In thirty-nine items on the questionnaire more than three-fourths of the pupils who said that the activities were very important also indicated that they did them either quite a bit or a great deal.

4. Conclusions. In general, the reactions and opinions of the pupils toward the unified studies program indicated satisfaction with the quality of the program, but indicated a need for more participation in certain activities, some to a greater extent than others.

The pupils indicated that they do not feel that any of these seventy activities have been overemphasized.

The interpretation of the results of the study would seem to indicate that in general, teachers are teaching what pupils think they should, and are emphasizing things that pupils feel are important.

Microfilm \$2.60; Xerox \$9.00. 197 pages.

#### A FOLLOW-UP STUDY OF STILLMAN COLLEGE GRADUATES

(L. C. Card No. Mic 60-3413)

Blanch Brewster Hardy, Ph.D.  
Michigan State University, 1960

Major Professor: Paul L. Dressel

This follow-up study of graduates of Stillman College (a four-year Negro college established by the Presbyterian Church in Tuscaloosa, Alabama) was undertaken for the purpose of securing information to guide the college in

evaluating certain aspects of its program. Information was secured concerning the college experiences of the graduates, their evaluation of these experiences, and their experiences and activities since graduation.

Ten broad questions were identified by consultation with the faculty and by study of other follow-up surveys. A detailed questionnaire was then prepared and mailed to 200 graduates who had received their degrees between 1951 and 1957. Responses were received from 140--41 men and 99 women.

#### Findings

Alabama, Tennessee, and Mississippi produced the majority of the graduates. Seventy percent were married and had an average of two children. Thirty-one percent owned their homes and 32 percent were renters. Most of their parents received only one to twelve years of education, but 61 percent of their spouses attended college.

A small proportion experienced difficulty with their courses; a majority found the library services satisfactory, but almost half of them said the material in the library and access to it were inadequate.

Participation in extracurricular activities was rather extensive; the men tended to exceed the women, and 85 percent and 67 percent--men and women respectively--said the program was satisfactory.

The major problems faced were academic and financial, and instructors were sought most often to help with their solution.

As adults these graduates engaged in the usual civic and social activities of their communities; the majority had a variety of reading material available, but pictorials, dailies, weeklies, cheaper novels and fiction predominated. For most of them the remaining leisure activities were: watching television, listening to radio programs, attending movies and sports events.

One-half of the graduates were school teachers. The majority (52.2 percent) of those reporting incomes earned \$2,499.00-\$3,499.00 and 14 percent earned \$3,500.00 up. A large majority liked their jobs and 42.2 percent planned to keep them.

As a group, the graduates were satisfied with their college experiences; however, 24 to 38 percent wished that more help had been given in economic, civic and inter-personal areas of life. The greatest concern was economic and personal security. The non-major courses of most value were: religion, philosophy, social science, English, psychology, chosen by 15-29 percent; their basic religious faith and practices had not changed and the program of Bible and religion was highly acceptable.

To improve the college program the graduates would: employ additional personnel; increase offerings in science, foreign language, and speech; and add courses for teacher-librarians and field experiences in social sciences and education. They would also increase the extracurricular activities and encourage more student participation; improve practices and procedures in all programs of the college and add facilities for instructional and guidance activities. Microfilm \$2.50; Xerox \$6.00. 125 pages.



OPERATIVE OBJECTIVES IN LITERATURE  
COURSES AS DETERMINED BY  
EVALUATION PRACTICES

(L. C. Card No. Mic 60-3714)

William Allen Ruf, Ed.D.  
The University of Buffalo, 1960

The purpose of this study was to discover operative objectives in the teaching of required literature courses in teachers colleges, and to examine their congruence with the stated aims of instructors of such courses.

Review of pertinent literature disclosed a lack of agreement among teachers of literature concerning the aims of their courses, and a tendency to vague statement of those aims upon which agreement was reached. Furthermore, the evaluation of student achievement by college instructors appeared to constitute a factor in shaping student goal concepts contrary to the aims of instructors. Particularly were tests and examinations found to contain such a factor.

A group of instructors in ten teachers colleges of State University of New York which prepare elementary school teachers was selected on the basis of their current involvement and experience in teaching required literature courses. A pilot study at one college refined the techniques employed. Findings represent a study of fifty instructors from the remaining colleges. Avowed aims were obtained by means of a questionnaire and interviews. To discover the objectives operative in their instruction, instructors were questioned on methods of grading, and an analysis of recent tests and examinations revealed the nature of the knowledge and abilities demanded of students. Descriptions of course content and program requirements were obtained from catalogs and through interviews with the instructors.

The programs in literature were found to vary quite widely, both in the semester hours required and in the content of individual courses, reflecting the disagreement on objectives reported in the literature. No other explanation was found for such variety of programs among institutions serving such similar purposes under a single administrative head.

The aims as stated and as implied in interviews were found to be generally consistent with the aims of literature as general education--appreciation, critical reading, self-understanding, proficiency in verbal skills. Notably absent was an aim related to the preparation of students for teaching; only one instructor stated that he systematically worked toward this end. All others, affirming the importance of literature in the education of their students, denied, often emphatically, any occupational objective in their teaching. This indicated that literature is considered in these colleges as largely a part of general education. That the instructors had had very little experience in elementary school teaching, that only four were graduates of teachers colleges, and that of twenty-eight doctoral degrees only one was the Ed. D., may partly explain this attitude.

The objectives seen as potentially made operative by examinations and marking practices were on the whole similar to those avowed. However, one emerged as pre-eminent--that of good written expression. Questionnaires indicated that all instructors penalized tests for faulty composition; interviews supported this finding, bringing out that grades on written work--examinations and other assignments--constituted at least half of the course mark, frequently more. Examinations, while varying in terms of

the objectives and subject matter stressed, were nearly unanimous in requiring long written answers and in admonishing students that the quality of writing influenced grades. Since examination grades weighed heavily in determining course marks, it was concluded that students might regard skill in written expression as a principal means of obtaining good marks. It was inferred that other, less concrete, objectives might thus become secondary.

Microfilm \$2.50; Xerox \$6.80. 142 pages.

FACTORS RELATED TO STUDENTS  
CHOOSING OR NOT CHOOSING  
TEACHING AS A VOCATION

(L. C. Card No. Mic 60-4803)

Albert Kerby Tink, Ph.D.  
Northwestern University, 1960

This study sought to discover:

Factors related to teachers' and students' choices of teaching,

Reasons students did not choose the teaching profession,

Whether the nature of student-teacher relationships affects student attitudes toward choosing teaching as a vocation,

The school grade or period of life when students made their vocational decisions to teach,

Whether there is agreement or difference of opinions about teachers and teaching existent among groups of high school students, college students, and teachers, and

Ways of helping those involved in recruiting teachers.

Since the current supply of teachers does not meet the national demand, information that shows what factors encourage people to enter the teaching vocation and what factors discourage students from entering teaching can, if used effectively, be of significance.

Data for the study were obtained from 914 high school students, 389 college students, and 132 teachers who represented eight high schools and six colleges in southeastern Wisconsin and northeastern Illinois.

Respondents who had made vocational decisions rated factors considered to be of significance in making vocational choices on the basis of a degree of influence each factor had in forming the respondent's vocational decisions. The ratings by the respondents were grouped according to sex, high school student, college student, or teacher, and in the case of students whether they might teach or did not plan to teach. Comparison of the ratings of vocational influence-factors between these groups was then possible.

For the purpose of reporting the data related vocational influence-factors were arranged in clusters and tables were constructed for visual summary.

A split-half method of testing tabulated results of the questionnaire was used for checking reliability. The correlations derived were high.

Students who may teach and teachers indicated on the basis of their ratings the five most influential factors in making their choice to teach to be: Teaching is interesting and enjoyable, teaching challenges the imagination, teachers enjoy working with pupils, teaching offers opportunity to work with favorite subject, and teachers get along well with pupils.

Such influence-factors as leadership responsibility, teaching experience, participation in extra-curricular activities, experiences as a leader of a group, taking care of children, and opportunities to direct activities, were rated significantly higher as vocational influence-factors by students who may teach than by those students who do not plan to teach.

Students not planning to teach gave as their reasons different vocational interests, unfavorable conditions associated with teaching, and personal inadequacies. Specific reasons most frequently mentioned were: Just not interested, low salaries, do not feel capable, other major interest, and too much schooling.

Three hundred eighty-nine respondents who were either teachers or students who definitely planned to teach reported when they had made their decision to teach. One-third made their decision to teach prior to tenth grade. One-quarter decided in grades 10, 11, or 12. Well over one-half of this particular group made the decision to teach prior to high school graduation. Women decided to teach at an earlier age than did the men.

There was general agreement by all respondents, whether teachers or students, whether planning to teach or not planning to teach, as to significance of various types of teacher characteristics.

Teachers in general have built a reservoir of good will concerning themselves and their methods according to the respondents, but they have not generally encouraged students to enter teaching.

Microfilm \$3.25; Xerox \$11.25. 250 pages.

## EDUCATION, THEORY AND PRACTICE

### A STUDY OF THE POSSIBLE CONTRIBUTIONS OF MODERN LINGUISTIC SCIENCE TO THE TEACHING OF THE ENGLISH LANGUAGE IN HIGH SCHOOL

(L. C. Card No. Mic 60-3549)

Virginia Alwin, Ph.D.  
University of Minnesota, 1958

Modern linguistic science has discovered certain underlying principles and numerous facts about the English language, most of which are not yet generally known by teachers of high school English. The prevailing high school English language teaching program is still strongly influenced by the doctrine of correctness in usage, which linguistic research has revealed to be unrealistic. Further, its content is largely the traditional Latin-based grammar, which research has shown does not really describe the structure and the operation of the English language. Con-

sequently what is being taught in the high school English classroom about the nature of language in general, and about English grammar and contemporary American English usage in particular, lags far behind the scholarship in the field.

One of the reasons for this educational lag is the tenacious hold of traditional grammar. This situation is like that in many fields of study: old and even disproved ideas do not give way easily to the new. A second reason is that the sources of information on the new findings, although now many in number, are not usually addressed to the in-service teacher of high school English, who consequently does not find them comprehensible. Furthermore, there are almost no materials yet available for use in teaching the recently discovered linguistic principles and facts to high school students.

The purpose of this study, then, was to gather, from many different sources, information on the English language discovered by modern linguistic science; to select that which, it was believed, could profitably be used by today's teacher of high school English; and to interpret and present it in a form and manner so that it would be comprehensible to the uninitiated in-service teacher. Then, on the basis of this new information, the study attempted also to organize and present a scholarly oriented and a practicable program for teaching the Nature of Language, the Usage of Language, and the Grammar of the English Language to the students in each of the six years of the junior and senior high school.

The investigator emerged from the study with several convictions. The first was that if the findings of linguistic science were understood, accepted, and taught by today's teacher of high school English, the results would be the elimination of these currently existing and undesirable situations: the teaching of language myths, notions, and half-truths; the developing of needlessly stultifying language attitudes; and the wasting of precious time on a grammar which does not really describe how the English language is built and how it works.

A second conviction was that the new linguistic information should be known and taught by the teacher of high school English simply because it is accurate and true. The findings of modern linguistic science are the facts; getting at the facts is important in every field of study.

A third conviction was that the new approach suggested by this study, that is, teaching students to learn by observation and induction, by research, and by the intelligent use of valid and up-to-date sources of information would bring the method of study in the English language teaching program up-to-date.

Besides developing these convictions, the study also brought up the question of whether or not the suggested new English language teaching program would actually help high school students to speak and write more effective English sentences.

Modern linguistic science has made certain principles and facts available. This study has interpreted and organized them for the teacher of high school English. It will now be his task to test the effectiveness of their use by scientifically controlled experiments in the classroom.

Microfilm \$2.75; Xerox \$12.40. 211 pages.



# AN ANALYSIS OF THE RADIO-TELEVISION TRAINING PROGRAMS IN INSTITUTIONS OF HIGHER EDUCATION

(L. C. Card No. Mic 60-3406)

Dale Norman Anderson, Ed.D.  
Michigan State University, 1960

Major Professor: Walker H. Hill

This study is an exploration of the general character and validity of present-day radio and television education in leading colleges and universities as seen by representative groups of educators, graduates, and broadcasters.

Its purposes are to: (1) ascertain the objectives of radio and television training programs in a representative group of institutions, (2) identify and analyze the curriculums of the training programs, (3) compare the curriculum patterns to the personnel needs and preferred employment qualifications of radio and television stations, (4) appraise the training programs in terms of specific recommendations for more effective and expert instruction, and (5) discover how an organization such as the Association for Professional Broadcasting Education can best serve the radio and television training programs in institutions of higher learning.

The normative-survey technique was employed. Three separate, yet interrelated, questionnaires were prepared and sent to institutions, to former students, and to broadcasting stations.

The following findings are among the most important resulting from the study:

1. Seven objectives were reported for the radio and television training programs. The most often stated objective was "to develop professional competence within the student."

2. General agreement was found between the institutions and the former students regarding the frequency with which 26 radio and television courses are offered, the frequency with which these courses are taken, and the importance attached to them. However, dissimilarities appeared in relationship to several courses. The former students believed their colleges had over-emphasized certain areas and under-emphasized others.

3. The institutions and former students agreed that production and programming are the industry divisions most emphasized in the training programs.

4. The majority of former students felt that the most valuable parts of their college work in relation to their professional careers were: (1) radio and television workshops, (2) liberal arts courses, and (3) radio and television courses.

5. The most frequent criticism by former students was the lack of commercial orientation and training in specific commercial procedures and practices.

6. The majority of former students indicated that their over-all expectations of the broadcast industry as derived from their training had been favorably substantiated.

7. Nearly 50 per cent of the former students rated their radio and television training as good and nearly 24 per cent rated their training as excellent.

8. Radio and television broadcasters experience their greatest difficulty in securing qualified personnel for the sales division. The engineering division was rated second most difficult by radio stations, and production was rated second by television stations.

9. Both radio and television broadcasters listed sales, programming, and engineering as the three divisions that would profit most from college-trained personnel--but not in the same order.

10. Substantial agreement was found between institutional and station respondents in rating the most essential qualifications for employment in the broadcast profession. However, the two groups disagreed on some qualifications.

11. The two most preferred services of a professional organization were: (1) "establish faculty-industry internships" and (2) "establish in-service scholarships for students."

Specific application of these findings to more effective instruction in radio and television is the predominant theme underlying the general conclusions of the study.

Microfilm \$3.80; Xerox \$13.30. 293 pages.

# A CRITICAL STUDY OF THE EVANSTON TOWNSHIP HIGH SCHOOL COMBINED STUDIES PROGRAM

(L. C. Card No. Mic 60-4735)

Leslee J. Bishop, Ed.D.  
Northwestern University, 1960

## THE PROBLEM

It was the purpose of this investigation to examine critically the Evanston Township High School Combined Studies Program taken by the 902 pupils enrolled in all four grade levels during the years 1955-58. The following areas were investigated: (1) Program development; (2) Purposes and organization; (3) Pupil expectations and enrollment trends; (4) Pupils' personal backgrounds, academic abilities, and college admissions; (5) Course content and methods; (6) Achievement in English grammar, mechanics and ability to interpret literary materials; (7) Achievement in U.S. history and in social studies skills; (8) Pupil roles in class leadership and in class management; (9) Parent and pupil appraisals; (10) Major problems and suggestions for improvement.

## PROCEDURES

Data were obtained by means of questionnaires and check lists to students, parents and the Combined Studies staff, from official Evanston Township High School and Combined Studies Department documents and materials, from interviews and observations, and through a series of objective tests in English and social studies. In appraising the effectiveness of the program, the conventional classes in English in the high school were used as the comparison group. In history and social studies skills, publisher's norms were used. In areas unique to the Combined Studies Program, comparisons were made between classes at the same and at different grade levels within the program.

## FINDINGS AND CONCLUSIONS

The Combined Studies Program, organized as a department in 1954-55, was the result of a series of curriculum innovations which included the New School 1937-1950, and the Core Program 1950-54. Enrollment in the Combined

Studies classes increased in both numbers and percentage during the years of the study.

The Combined Studies Program through the parent, department, and inter-class organization sought objectives of personal development, cooperative problem solving, academic knowledge and appropriate skills. Stress on basic skills was a direct result of the objectives and methods employed. The Combined Studies pupils were representative of the total high school population in family background and academic ability, although a higher percentage attended college.

Achievement data in English mechanics, grammar and literary interpretation indicated that pupils in Combined Studies did as well or better than pupils in the comparison groups. In U.S. history and social studies there was marked superiority of the Combined Studies pupils over the suggested publisher's norms. A majority of the students participated in significant leadership responsibilities and in other class management functions and responsibilities.

In their appraisal, parents reported as outstanding the contribution of the program to the individual development of the pupils, and in their judgment the program was best achieving its goals in the areas of pupil participation and communication skills. Next highest ratings were given to subject matter achievement, pupils' ability to evaluate and to perceive relationships, class reading programs, and information to parents.

Students, in their evaluations, stressed the values of the participation aspects, the democratic classroom procedures, the development of skills contributing to independent work, interest, achievement in content, and desirable teacher-pupil relationships.

Problems faced by the program were occasioned by the current state of flux in American education and the local competition for able pupils. Immediate problems included those arising out of the use of new methods, the need for appropriate facilities and trained teachers, and the need for staff time for working with pupils.

Suggestions for improvement included: improved communication, student orientation, program evaluation, clarification of the unique role of Combined Studies, reorientation and redefinition of the parent organization, improved methods and facilities, a new rationale for the core curriculum idea, and the clarification of the role of the school in the education of young citizens.

Microfilm \$5.15; Xerox \$18.25. 401 pages.

#### THE VIEWPOINTS OF JOHN DEWEY ON SELECTED QUESTIONS FROM CURRICULUM THEORY

(L. C. Card No. Mic 60-4736)

Daniel Raymond Bock, Ed.D.  
Northwestern University, 1960

The purpose of the study was to examine selected writings of John Dewey for his viewpoints on questions from contemporary curriculum theory. An examination of the literature in the field of contemporary curriculum theory indicated to the writer that the following questions seemed to be most relevant.

- 1) What shall be the content of the elementary school curriculum?
- 2) How shall the elementary school curriculum be organized?
- 3) How shall the elementary school curriculum be evaluated?
- 4) Who shall be responsible for determining the content, organization, and evaluation of the elementary school curriculum?

It was noted that Dewey's view was that the content of the curriculum must have a social orientation. This included all the areas of learning like arithmetic, art, or history. Subject matter had meaning as it was used as means to bring about consequences, means to prevent undesirable consequences, or consequences for which proper means had to be discovered. It was apparent that one could not turn to Dewey's writings for specific subject matter which could then be transplanted into any given curriculum. Each school must work out its own subject matter depending on the needs of that school.

It was the writer's interpretation that it would probably be some combination of a core and an experience curriculum that would come closest to Dewey's views on curriculum organization. The types of cores which would take precedence would vary from school to school depending on location, the background of patrons, and the times. The organizing, or core, element which Dewey stressed most was the study of occupations. He would have the children participate in these occupations, not to make them weavers, gardeners, or cooks, but to give them insights into industrial society and the use of these occupations as springboards into more intellectual pursuits.

Dewey felt that evaluation must be an ongoing process in which constant research was necessary. It would be within the actual classroom in operation that the evaluation and research was to take place. An important part of evaluation had to do with judging the unification of ends-in-view and the means for their accomplishment. Dewey believed that curriculum change was to be constant and that it should evolve in an orderly, progressive fashion, a step at a time. Evaluation was to be a continuous process involving all aspects of the curriculum that contributed to that orderly evolution.

It was Dewey's contention that education was to help clarify for society its goals as these goals pertained to education. This placed a leadership role upon the schools. As regards direct responsibility for determination of the content, organization, and evaluation of the curriculum, Dewey was quite emphatic in saying that this was primarily the job of the teacher. The administrators would have their part to play, but the major role must be played by the teacher. Dewey was equally firm in his opinion that the lay citizen must tread carefully in curriculum matters or risk becoming a meddler.

Finally, it was noted that Dewey did not concern himself with the fine points of curriculum content, organization, and evaluation. He was more concerned with a philosophical conception of these problems. He indicated that pre-planning of the curriculum was necessary. This would appear to call for a written document of some sort. But it was still and basically the job of the teacher to put the



curriculum into effect and to modify it as occasions arose. Flexibility in curriculum matters was of supreme importance. Microfilm \$2.50; Xerox \$5.60. 113 pages.

AN EVALUATION OF A TECHNIQUE TO  
IMPROVE SPACE PERCEPTION ABILITIES  
THROUGH THE CONSTRUCTION OF MODELS  
BY STUDENTS IN A COURSE IN  
SOLID GEOMETRY

(L. C. Card No. Mic 60-2107)

Louis Cohen, Ph.D.  
Yeshiva University, 1959

Supervisor: Dr. Philip Kraus

A. Problem: The purpose of this study was to determine whether the construction of models by students during their study of solid geometry would improve their space perception abilities.

B. Procedure: The test groups consisted of sixty-three pairs of seniors who were attending a New York City high school which specialized in mathematics and science. Each student had successfully completed Ninth Year Mathematics (elementary algebra), Tenth Year Mathematics (plane geometry), Eleventh Year Mathematics (intermediate algebra and plane trigonometry), one-half year of advanced algebra and one year of mechanical drawing. The pairs were matched with respect to age, intelligence quotient, sex, grades in the Tenth Year Mathematics regents examination, grades in the Eleventh Year Mathematics regents examination, average mathematics grades received from teachers, general scholastic average and grades received in mechanical drawing.

Before the control and experimental groups began the study of solid geometry, each had administered to it a battery of tests designed to measure aspects of space perception abilities. Five months later, after the completion of the course, the groups were re-examined. The gains on the tests were analyzed for significant differences.

The three teachers taking part in the study (each taught a control and an experimental group) used a standard solid geometry syllabus to which had been added a unit of solid analytical geometry. In addition to teaching all topics, theorems, etc., in the same sequence, they established criteria on the basis of which twenty-two models were selected for construction. These models were constructed by all students in the experimental but not by those in the control groups.

C. Sources of Data: The instruments used to measure significant differences between the control and experimental groups were the Revised Minnesota Paper Form Board Test, Forms A and B, the Space Relations Test, Forms A and B, of the Differential Aptitudes Tests and the local school final examination in solid geometry.

D. Summary of Findings: An examination of the gains of the sixty-three pairs of matched students in the control and experimental classes on the Revised Minnesota Paper Form Board Test showed that there was no significant difference in their performance. An analysis of the gains on the Space Relations Test of the Differential Aptitudes Test revealed that there was no significant difference in the

performance of the two groups at either the 1% or 5% levels of significance. With respect to the school final examination, which did not specifically measure space relations, both groups performed about equally as well. When the intelligence quotient scores were correlated with the gains on the tests, the correlation coefficient was statistically equal to zero.

E. Conclusion: There is no justification for the claim that construction of models by students during their study of solid geometry will further growth in ability to visualize. Microfilm \$2.50; Xerox \$5.40. 108 pages.

A COMPARATIVE STUDY OF FIFTH GRADE  
CHILDREN WHO ARE SUCCESSFUL AND  
UNSUCCESSFUL IN READING

(L. C. Card No. Mic 60-4324)

John Maxwell Dodd, Ed.D.  
University of Kansas, 1960

This study was conducted to investigate the possibility of differences between successful and unsuccessful readers. Fifteen fifth grade successful readers were compared with 15 fifth grade unsuccessful readers on the basis of academic achievement, intrapersonal and interpersonal achievement, visual perception, and non-language and language mental age scores.

Procedure

The California Short-Form Test of Mental Maturity and the Stanford Achievement Test were administered to the fifth grade children in Lawrence, Kansas. Each child's chronological age and California Short-Form Test of Mental Maturity total mental age were combined to determine an expected reading level. Children estimated by the average reading score, derived from the Stanford Achievement Test, to be reading one or more years below their expected reading level were considered unsuccessful readers. Children reading at or above their expected reading level were considered successful readers.

The unsuccessful readers were compared with the successful readers on the basis of the following: the subtests of the Stanford Achievement Test, the California Test of Personality, a Children's Questionnaire, prepared at the University of Kansas Bureau of Child Research; the Gates Diagnostic Reading Tests, the non-language and language California Short-Form Test of Mental Maturity mental age scores, the Werner-Strauss Picture Tests and Marble Board Test, and a Teacher Rating Form.

The results of the comparison of the unsuccessful readers with the successful readers revealed significant differences between the mean achievement score on the following Stanford Achievement subtests: Spelling, Language, Social Studies, and Science. Considerably more unsuccessful readers than successful readers achieved scores in Arithmetic Computation which were among the highest third of their own achievement test results.

There were significant differences between the means of the groups on Oral Vocabulary and Oral Reading as measured by the Gates Reading Diagnostic Tests. The unsuccessful readers' greatest number of errors in oral

reading was the result of repetition of words. The unsuccessful readers also gave wrong endings for words and added words frequently. Many of their errors were the result of making mistakes on several parts of words. Comparatively few of their errors were the result of omissions, wrong beginnings, or wrong middles of words.

There were significant differences between the successful readers and the unsuccessful readers in regard to their performance on the following subtests of the Gates Reading Diagnostic Tests: Reversals, Phrase Perception, Recognition of Syllables, Recognition of Phonograms, Blending Letter Sounds, Speed of Reading Small Letters, Giving Letter Sounds, Speed of Reading Capital Letters, Blending Letter Sounds (auditory), Reading Small Letters, and Giving Words for Ending Sounds. The successful readers achieved considerably better than the unsuccessful readers on the following subtests: Word Perception, untimed presentation; Syllabication, and Giving Letter Sounds for Ending Sounds of words. The differences between the groups in regard to their ability to read accurately capital letters seemed negligible.

The differences between the groups on emotional and social achievement were not significant as estimated by the Teacher Rating Form on the California Test of Personality. The results of the sociometric question in the Children's Questionnaire revealed significant differences between the groups.

There were significant differences between the groups on the language and non-language sections of the California Short-Form Test of Mental Maturity.

The results of the Children's Questionnaire revealed no significant differences between the groups in regard to the children's estimates of their own ranks within their classes and whether added effort would change their ranks. There were no differences between the groups in regard to the children's attitudes toward school, as indicated by the Children's Questionnaire.

There were no significant differences between the groups on the results of the Werner-Strauss Picture Tests, but there were significant differences between the groups on the results of their Marble Board Test performances.

Microfilm \$2.50; Xerox \$8.20. 180 pages.

#### A COMPARATIVE STUDY OF THE ADJUSTMENT PROBLEMS OF EGYPTIAN AND AMERICAN HIGH SCHOOL STUDENTS WITH IMPLICATIONS FOR GUIDANCE

(L. C. Card No. Mic 60-2998)

Osman Labib Farrag, Ed.D.  
Indiana University, 1960

Chairman: Louis G. Schmidt

**Problem:** The purpose of the study was to identify and compare the adjustment problems of Egyptian and American high school students. A further purpose was to compare the problems of Egyptian boys and girls and of those in grades 10, 11, and 12.

**Procedures:** The SRA Youth Inventory, Form S, was used to identify the problems of 250 American boys and girls from grades 10, 11, and 12. The same instrument was translated into Arabic and administered to 276 Egyptian boys and girls of similar ages and educational level.

A frequency score and an intensity score were obtained for each student. The rank order correlation was used to find the correlation between the ranks assigned to each problem area by the Egyptian and by the American students. The t-ratio was used to test the significance of the difference between the means. Further comparisons were made between the ten problems most frequently mentioned by students from both groups. Also comparisons were made between Egyptian boys and girls and between students from grades 10, 11, and 12.

**Findings:** (1) The Egyptian students marked more problems than did the American students. (2) The correlation between the ranks assigned to the problem areas by the Egyptian students and those assigned by the American students was significantly high. (3) The "After High School" Area was ranked first by the two groups on the basis of both the frequency and the intensity scores. (4) The mean intensity scores for the Egyptian subjects were significantly high at the .01 level. (5) Egyptian girls marked more problems than did Egyptian boys and assigned different ranks to the problem areas. (6) Egyptian students in grade 11 marked more problems than did students in grades 10 and 12; however, the rank correlation between each two grades was significantly high.

**Conclusions:** (1) The SRA Youth Inventory could be translated to the Arabic language and still carry the same meaning as the English form. As an instrument for identifying adjustment problems, it proved to be helpful in pointing out differences and similarities in the patterns of problems of different groups. (2) The findings suggest that at the senior high school level the differences between the problems of Egyptian and American students are in intensity rather than in kind. (3) The great number of problems marked by the Egyptian students and the variety and the nature of these problems are indications of the urgent need for guidance services in the Egyptian schools. (4) The effective guidance services that have proved beneficial in the United States could be used as a guide in planning guidance programs for Egyptian schools. (5) It is believed that further research is needed in the area of problems of adjustment. More comprehensive studies among groups from different cultures are needed.

Microfilm \$2.50; Xerox \$8.40. 182 pages.

#### A COMPARISON OF THE POSTULATIONAL APPROACH AND THE TRADITIONAL APPROACH IN TEACHING SELECTED TOPICS IN ALGEBRA TO ABOVE-AVERAGE STUDENTS

(L. C. Card No. Mic 60-2108)

Samuel Louis Greitzer, Ph.D.  
Yeshiva University, 1959

**Problem.** -- The purpose of this study was to determine the effect on above-average students when selected topics in eleventh-year mathematics (intermediate algebra) are presented to them through a modern postulational approach rather than through the traditional inductive method.



**Procedure.** -- The students involved in the study were selected from the Junior class of June, 1957 at the Bronx High School of Science, a specialized school for students with interest in mathematics and science. Admission to this school involves an entrance examination, part of which is in mathematics. From these students, fifty-five pairs of students were selected, each pair being matched on the basis of age, I.Q., entrance examination mark in mathematics, algebra mark, Regents' examination mark in geometry, and sex. Each pair also had the same teacher.

While the control group pursued the normal course of study in eleventh-year mathematics for one semester, the experimental group was taught by a set of twenty-four lessons interspersed in the term's work. These lessons consisted of selected topics in the algebra sequence, developed by means of the postulates of group theory and field theory.

Six medial tests and the departmental final examination supplied the data which were used to arrive at findings and conclusions. Of these tests, the first two were so constructed as to make it possible to measure the degree to which the experimental group was absorbing the postulational method. The other tests were used to test relative ability in subject matter areas.

**Summary of Findings.** -- The first two tests showed that the experimental group was reacting successfully to the postulational approach. The other medial tests and the departmental final examination results showed no significant differences between experimental and control groups as far as mastery of content was concerned. In the experimental group, there was no correlation between ability in the postulational material and I.Q. There was a small but persistent bias in favor of the experimental group in seven tests out of eight, the cumulative effect being statistically significant.

**Conclusions.** -- On the basis of the findings listed above, the following conclusions are drawn:

1. Selected topics in intermediate algebra can be presented to above-average students effectively through a modern approach;
2. These students are capable of absorbing, understanding, and applying the postulational method;
3. These students can do as well as, or better than, students with whom the traditional approach has been used;
4. Among these students, ability with the postulational method appeared to be independent of I.Q.

**Suggestions.** -- The following research topics are suggested:

1. An extension of the postulational approach to all the content of eleventh-year mathematics for above-average students, with investigation of results;
2. Introduction of the postulational approach in the twelfth year of mathematics for above-average students, possibly with the addition of set theory;
3. A similar experiment with average students.

Microfilm \$2.50; Xerox \$6.60. 140 pages.

# A COMPARISON OF TWO TEACHING METHODS, INDIVIDUAL AND GROUP, IN THE TEACHING OF WORD IDENTIFICATION IN BEGINNING READING: TO SELECTED FIRST GRADE CHILDREN IN THE PUBLIC SCHOOLS OF GREAT NECK, NEW YORK.

(L. C. Card No. Mic 60-3771)

Ruth Kelley Izzo, Ed.D.  
New York University, 1960

Chairman: Associate Professor George Manolakes

## Problem

To compare the relative effectiveness of two teaching methods, individual and group, in the teaching of word identification in beginning reading to selected first grade children in the public schools of Great Neck, New York.

## Experimental Design

Two groups--an experimental and a control group--of sixty-eight children each were formed from eight first grade classrooms. These groups were equated on the bases of reading readiness as measured by the Lee-Clark Reading Readiness Test, mental maturity as measured by the California Short Form Test of Mental Maturity, kindergarten experience, age, sex, number, and teacher evaluation. In the experimental group, the planned developmental instruction in word identification was given to one child at a time; in the control group, this instruction was given to more than one child at a time. The children were taught by teachers who had expressed willingness to participate in the study; were pursuing either an individual or group method for their planned instruction in reading; and had been evaluated as competent by a jury. All teachers participating in the study were certified teachers in New York State and were selected on the basis of equivalence of educational qualifications and teaching experience.

For a period of seven months, beginning in October of 1958, observations of the eight classrooms were made to: (1) obtain anecdotal records pertaining to word identification, (2) observe the methods, and (3) help maintain the distinct quality of each method.

The California Reading Test was administered in May, 1959 to each child in the experimental and control groups. An analysis was made of the data obtained to ascertain the relative effectiveness of the two teaching methods. The achievement of each group, experimental and control, was studied. The critical ratio (t-test) was used to test the means of the groups. The variances of the scores were tested by the F-ratio. A chi-square test was applied to the results obtained by each group, experimental and control, on each of the four sections of the California Reading Test: word-form, meaning of opposites, word recognition, and picture association. A study was made of the achievement of the girls, the boys, the oldest of each group, and the youngest of each group.

## Findings

Within the limitations of the experimental design, the following statements summarize the major findings:

1. No significant difference was found in the relative effectiveness of the two teaching methods, individual and

group, in the teaching of word identification in beginning reading to selected first grade children in the public schools of Great Neck, New York.

2. The children of this study who experienced group instruction in reading tended to perform more effectively in the use of phonetic analysis.

3. The children of the experimental group performed as effectively as the children of the control group in the use of word form, meaning of opposites, and picture association.

4. The girls who experienced individual teaching tended to perform as effectively in the use of word identification as the girls who were taught in a small group; likewise, the boys taught individually tended to perform as effectively as the boys who were taught in a group.

5. The youngest and the oldest first grade children tended to use word identification effectively whether they were given instruction in word identification individually or in a small group.

Microfilm \$2.50; Xerox \$5.60. 115 pages.

#### SOME EFFECTS OF BELIEFS ABOUT CONCLUSIONS OF ARGUMENTS ON THE ABILITY TO JUDGE THE VALIDITY OF THE ARGUMENTS

(L. C. Card No. Mic 60-3936)

Robert Bignal Kane, Ph.D.  
University of Illinois, 1960

If the ability to think logically should be developed in the schools, then an intensive study of this complex mental process is indicated in order that sound procedures for enhancing an individual's opportunities to develop in this area may be devised. One goal in this research field is to discover the role of such factors as opinions, beliefs, and biases on an individual's ability to reason logically. This study investigated the effect of a strong bias toward a statement on the ability to judge the validity of an argument leading to that statement as a conclusion.

The research hypotheses investigated were that (1) people tend to accept invalid reasoning as valid if it leads to a conclusion with which they agree and to reject valid reasoning as invalid if it leads to a conclusion with which they disagree and (2) this tendency is stronger if the bias is reinstated shortly before judging the validity of the argument.

A test composed of two kinds of items was constructed. One set of items consisted of thirty-two statements with each of which the subjects were directed to agree or disagree. The other set of items consisted of thirty-two arguments whose conclusions were the thirty-two statements mentioned above. Subjects were instructed to mark each argument as valid or invalid. Each subject responded to one-half of the items by agreeing or disagreeing with the conclusion statements prior to judging the associated arguments as valid or invalid; this order was reversed on the other half-test. On the half-test in which the agree-disagree decisions preceded the valid-invalid decisions, the subject's opinions on the conclusion statements are reinstated immediately before making the valid-invalid judgments because he must take a stand on each of the

statements just prior to judging the arguments as valid or invalid. On the other half-test no such reinstatement is present because the valid-invalid decisions preceded the agree-disagree decisions.

Experiments were conducted with three distinctly different kinds of subjects, high school students enrolled in elementary algebra or geometry, college seniors in various teacher-training curricula who had no formal training in logic and college students who were completing a three-semester-hour course in logic. Four matched groups were selected in each experiment; each group responded to the test items in one of the four ways listed below:

- a. First half-test: agree-disagree judgment followed by valid-invalid judgment. Second half-test: vice versa.
- b. First half-test: valid-invalid judgment followed by agree-disagree judgment. Second half-test: vice versa.
- c. Second half-test: agree-disagree judgment followed by valid-invalid judgment. First half-test: vice versa.
- d. Second half-test: valid-invalid judgment followed by agree-disagree judgment. First half-test: vice versa.

This design balanced the test with respect to order effects.

The results of the analysis of data from each of the three experiments affirm that in the populations studied, people tend to accept invalid reasoning as valid if it leads to a conclusion with which they agree and to reject valid reasoning as invalid if it leads to a conclusion with which they disagree. The results of the analysis of data from the college senior and logic student experiments affirm that the above tendency is stronger if the bias is reinstated shortly before judging the validity of the argument. Results in the high school experiment are contradictory with respect to whether or not reinstatement of opinion on conclusion statements shortly before judging the validity of the associated arguments produces a stronger tendency toward the above bias.

Microfilm \$2.50; Xerox \$5.40. 109 pages.

#### TO DEVELOP A BASIS FOR ACHIEVING THE EXPLORATION FUNCTION IN THE JUNIOR HIGH SCHOOLS OF THE UNITED STATES

(L. C. Card No. Mic 60-5211)

Nathan Krevolin, Ph.D.  
The University of Connecticut, 1960

#### STATEMENT OF THE PROBLEM

The problem of this study is: What is a satisfactory basis for providing exploration through the curriculum of the junior high school?

#### DEFINITION OF EXPLORATION

To lead pupils to discover and explore their specialized interests, aptitudes, and abilities as a basis for decisions regarding educational opportunities.



To lead pupils to discover and explore their specialized interests, aptitudes, and abilities as a basis for present and future vocational decisions.

To stimulate pupils and provide opportunities for them to develop a continually widening range of cultural, social, civic, avocational, and recreational interests.

### SCOPE OF THE STUDY

This study was limited specifically to three-year junior high schools. Junior high schools in the forty-nine states and the District of Columbia were included in the study.

### PROCEDURES EMPLOYED

There were three major steps in this study:

1. The practices now being used to provide for exploration in the junior high schools in the United States were surveyed.

2. The points of view of leaders in junior high school education concerning the meaning of exploration and the ways of implementing it were ascertained.

3. A recommended basis for exploration practices in the junior high school was developed in terms of the literature on the subject, present practices in junior high schools, and the opinions of specialists in junior high school education.

### CONCLUSIONS

1. Exploration today is still considered to be a basic function of the junior high school. Furthermore, there is much evidence to show that the attention given to exploration in the junior high school has increased during the past decade.

2. Exploration in the junior high school today extends into the entire curriculum of the school, rather than being limited to certain courses or activities.

3. The concept of exploration which is accepted today is a broad one which extends into every area of human knowledge, interest, and endeavor. It includes such interests as educational, cultural, vocational, social, civic, and avocational.

4. In most junior high schools a definite attempt is being made to help teachers become better acquainted with the individual interests, aptitudes, and abilities of pupils as a basis for more effective exploration.

5. In most junior high schools, pupils are provided with information about the educational program and activities in their junior high school, as well as information about the programs of the senior high school and of post-secondary schools.

6. In most of the junior high schools today, much of the opportunity for exploration is provided through methods or techniques of teaching rather than through the subject matter content of courses.

7. On the whole, the practices that are used in the junior high school today to implement the exploration function are those which are considered most desirable for this purpose by specialists in junior high school education.

8. In general, opportunities for exploration seem to be provided in the large junior high schools, particularly through a broad curriculum, wide offering of activities, guidance services, and extensive facilities. In the small junior high schools exploration is encouraged particularly through flexible methods of teaching.

9. There are no great differences by geographic areas in the practices employed for exploration in the junior high school. There is one exception; namely, that in the junior high schools of the Northeast pupils are given more vocational information than in schools in other geographic areas. Microfilm \$2.50; Xerox \$8.20. 178 pages.

### A STUDY OF EXPERIMENT PLANNING IN COLLEGE GENERAL CHEMISTRY, AN INVESTIGATION OF THE PERSISTENCE OF AN INDOCTRINATED PATTERN OF EXPERIMENT PLANNING SUBSEQUENT TO THE INDOCTRINATION PERIOD.

(L. C. Card No. Mic 60-3753)

Warren Anthony McMullen, Ph.D.  
New York University, 1960

Chairman: Professor J. Darrell Barnard

In light of (1) the desirability of providing for students laboratory experiences that are so similar to scientific research as (a) to help laymen understand the function of science in society, and (b) to train scientists who are better able to cope with problems which they meet in their work, and in light of (2) the controversy over the existence of "the scientific method" (the existence of a widely used sequence of steps in attacking problems), this study has determined the extent to which the experiment-planning patterns of a group of students in college general chemistry followed a recommended pattern subsequent to an indoctrination period.

Prior studies of student-planned experiments have shown that students tended to gain more skill in laboratory manipulation, more skill in certain aspects of scientific thinking, and more interest in science from such experiments than from more conventional laboratory work. Previous studies of problem solving have observed behavior patterns in simulated problem situations of low to moderate complexity.

There were four stages in this study. First, a recommended pattern of experiment-planning was derived from literature on skillful thinking. This pattern, a series of five steps to be followed, was embodied in a students' guide entitled Explorations in Chemistry. This guide was prepared to aid in indoctrinating students in the use of the pattern, to guide them in developing good laboratory manipulative techniques and good habits of recording and reporting laboratory work, and to provide problems to be used as the basis for planning experiments.

Second, the 1957-58 general chemistry class at Greenville College was indoctrinated in the use of the recommended pattern of experiment-planning through the use of Explorations in Chemistry and through group work in devising experiments to test hypotheses as to solutions of four problems. Then each student was assigned his own series of problems for which experimental tests of proposed solutions were to be planned. Throughout the course, students kept specified records of their own activities as they planned experiments.

Third, the student records of planning were studied to derive the pattern of experiment-planning used by each student for each experiment. Criteria for classification of

items in these records were secured by adapting material on the planning steps in Explorations in Chemistry. The criteria and their use in deriving patterns were validated by a jury. The reproducibility of the derived patterns was demonstrated.

Fourth, the derived patterns were examined to determine their likeness to the recommended pattern. For the class as a whole, there was no tendency to follow the indoctrinated pattern during the three quarters of the course following indoctrination more frequently than to follow all alternative patterns combined. Individual students showed wide variation in their tendency to follow the recommended pattern. From zero to one hundred percent of a given individual's patterns were like the recommended pattern. Forty-three percent of the patterns which were found were like the recommended one. The correlations between a given student's percent of patterns like the recommended one and the following were found to be not significantly different from zero:

Percentile ranks on the American Council on Education Psychological Examination

Scores on the American Council on Education Test of Critical Thinking

Scores on the American Chemical Society General Chemistry Test

Over eighty-five percent of the post-indoctrination patterns were either like the recommended pattern or omitted only the first of the five planning steps.

This study could well be followed by a series of studies to check its findings and to extend them to other subject matter fields and to chemistry as well as to other sciences for longer periods of time.

Microfilm \$2.50; Xerox \$8.40. 183 pages.

#### AN EXPERIMENT IN DEVELOPING CRITICAL THINKING THROUGH THE TEACHING OF AMERICAN HISTORY

(L. C. Card No. Mic 60-3758)

Arnold Rothstein, Ph.D.  
New York University, 1960

Chairman: Professor Louis E. Rath

Among the expressed goals of secondary education is the purpose of teaching students to think. It was the object of this investigation to explore how this could be done. Two groups of eleventh grade students were matched on the basis of test scores in mental abilities, English reading, and critical thinking skills. The hypotheses stated that, in the group where there was concentrated emphasis on the goal of thinking, there would be no loss in the acquisition of subject-matter content. Yet, in this group, greater gains in the ability to think critically would be achieved than in the group where there was incidental emphasis or where thinking was presumed to be a derivative of subject-matter acquisition.

The study encompassed exploration of the literature and analysis and exposition of the thinking processes so

that guiding principles could be abstracted and curricular materials improvised to provide for those activities in which the experimental class was to engage. American History--the vehicle through which the experiment was tried--was studied, for a period of thirty-five weeks, with a view to:

1. comparing sources of various kinds
2. interpreting data, drawing inferences, and finding assumptions
3. identifying strong and weak arguments
4. evaluating thinking as to its relative criticalness or dogmatism
5. developing sensitivity to language and meaning
6. augmenting student ability to draw conclusions from evidence and in differentiating fact and judgment.

The evidence presented by the investigation seems to support the following inferences:

1. As measured by the tests used, American History taught in the manner described developed a student's ability to do critical thinking more so than a course as presented "conventionally" to a comparison group.
2. Subject-matter achievement, as outlined in the school syllabus and as measured by the test used, was attained equally as well by the experimental method as by the conventional method.
3. The ability to achieve a satisfactory score on an informational examination is no guarantee that the individual will score similarly on a thinking test. The scores on both type-tests do not relate significantly.
4. There appeared to be no significant correlation between critical thinking and other school grades.
5. Though there was a positive correlation between such factors as I.Q., reading ability and critical thinking ability, the extension that these abilities are necessarily synonymous is not warranted.
6. On the basis of an analysis of monthly projects and of the class answers to various exercises, it is possible to assert that reflected in these were indications of the breadth and depth aimed for in the experimental course. The students' work expressed broadened perspective and "free play" of the mind.
7. Students in the experimental course were prone to discuss its content thus revealing some degree of enthusiasm for the course. A majority of the students recognized the relationship of their work to daily life and endorsed it as such.
8. In the judgment of the members of the experimental class, thinking was the most useful aspect of the course albeit that, during the term, concern for the passing of the final examination was registered.

It is clear that growth in thinking ability can be expected to derive from focused instruction; that when there is such focus, the students reflect in their test scores increased ability to apply the techniques. The study suggests that new methods and materials need to be employed and that these, for the most part, are best developed by the individual teacher. If a purpose of teaching is to elicit thinking on the part of students, there is the implication that teacher-training institutions will have to include in their methods courses an emphasis on the teaching of thinking. Microfilm \$7.05; Xerox \$25.00. 555 pages.



**A STUDY OF THE SCIENCE INTERESTS OF  
SELECTED STUDENTS IN GRADES SEVEN  
THROUGH NINE AND THE INFLUENCE  
WHICH THESE INTERESTS HAVE ON THE  
SCIENCE ACHIEVEMENT OF THE STUDENTS**

(L. C. Card No. Mic 60-3763)

Alyce Amelia Woloson, Ph.D.  
New York University, 1960

Chairman: Professor C. W. Barnes

**Problem**

The problem of this study was to determine the variety of science interests which high and low I.Q. boys and girls of grades seven through nine possessed and the extent to which the degree and type of science interest influenced their achievement in junior high school science. In addition, the science achievement of one group of ninth grade students who were allowed to follow their specific science interests was compared to the science achievement of another group of students who were required to follow a syllabus.

**Procedure**

"Activities Related to Science" and "Science Problems" were two instruments devised for this study. The first was the result of a careful study of activities in which junior high school students participated and those which they preferred to avoid. For several years the investigator, while teaching general science, compiled a list of these activities and this list was divided into two categories; those the students enjoyed doing voluntarily; those in which they were not interested. This list was compiled from comments made by the students concerning places they visited, things they saw and out-of-school activities which they did or did not enjoy. Special note was taken of projects, bulletin board displays and experiments which were done as required class assignments and a list was kept of the classroom demonstrations in which they were particularly interested and those in which they showed very little interest.

At the time the list of activities was being collected, a list was also compiled of questions that students asked and

which evoked classroom discussion. Those which aroused no interest were eliminated, and only those which brought forth discussion were kept and included in the instrument "Science Problems." Both instruments were tested on junior high school students several times and after each trial, test revisions were made until they were finally submitted to a jury of three experienced science teachers. These teachers indicated which of the sciences, physical or biological, was implied by each of the activities or each of the science problems.

At the beginning of a four month experimental period, one group of ninth grade students was allowed to compile a list of ten physical and/or biological science topics which they wanted to study. Each student did all the necessary research for pre-selected topics, worked on demonstrations or experiments, made models, drew charts and included all information gathered in a written report. The other group followed the procedure as outlined in a course of study for the school, and in this manner studied only physical science topics.

**Findings**

The newly developed instruments "Activities Related to Science" and "Science Problems" revealed that the seventh, eighth and ninth grade classes, when each class was considered collectively, were more interested in biological sciences than in physical sciences. The seventh grade girls indicated a greater interest in both physical and biological science than the boys. The eighth grade boys showed a greater interest in both physical and biological science than the girls and in the ninth grade the girls were most interested in biological science, while the greatest interest of the boys was in the physical sciences.

Ninth grade students permitted to study topics of their own choosing did not achieve significantly higher in science than ninth grade students who had no choice in the topics to be studied. Case studies of twenty randomly selected ninth grade students revealed that activities participated in in the classroom, questions asked in class, hobbies and vocational choices were all very closely related to expressed interest in physical or biological science as determined by the instruments "Activities Related to Science" and "Science Problems."

Microfilm \$2.85; Xerox \$9.90. 217 pages.

## ENGINEERING

### ENGINEERING, AERONAUTICAL

#### THE EMERGENCE OF THE ENGINEERING TECHNICIAN IN AVIATION

(L. C. Card No. Mic 60-3747)

Walter Magnus Hartung, Ph.D.  
New York University, 1960

Chairman: Professor Alonzo F. Myers

#### Statement of the Problem

This study is concerned with the origin and development of the engineering technician in aviation in the United States to include the role in aviation for which the engineering technician is prepared and the relationship of his education to the aviation industry from 1944 to 1959.

The specific problems of this study are:

1. To review and analyze the establishment of the Engineers' Council for Professional Development accreditation procedure for technical institute programs and the status thereby acquired by the graduate of these programs which led to the justification of the engineering technician title.
2. To review the role for which the current engineering technician graduate is prepared by those technical institutes in aviation offering programs accredited by the Engineers' Council for Professional Development.

#### General Procedure

The historical method is employed generally and considerable factual data are presented. The study includes an interpretation of relationships, an evaluation of trends, and a development of conclusions as to the significance of the engineering technician in aviation.

Significant events in aviation are related to the development of technical education. The engineering technician concept is reviewed and the accreditation of technical institute programs is presented. A composite study of technical institute curricula precedes an analysis of the role of the engineering technician in aviation. A study of the personal status of the engineering technician leads to a review of trends in the educational area, the aircraft industry and society.

#### Sources of Information

Historical sources in aviation and education were used in this study. Data relating government to aviation were obtained from secondary historical sources and government publications. Accreditation information in the files of the Engineers' Council for Professional Development was used. Historical information concerning technical institute programs was available in annual reports, com-

mittee reports and correspondence. Statistical and factual data from professional and educational organization sources were used.

Information concerning technical institute programs was available in the files and catalogs of the four institutions in this study. The results of technical institute graduate surveys were provided for reference. The results of a recent national survey of technical institute education conducted by the American Society for Engineering Education were available for analysis.

The candidate conducted interviews concerning the functions of the engineering technician in industry with those familiar with the utilization of engineering personnel. Government reports contained valuable statistical data concerning employment in aviation. Industrial publications were a valuable source of information.

Reference was made to texts concerning accepted historical research procedure. Standards for written work and examples of good dissertation practice were followed.

#### Findings and Conclusions

The engineering technician in aviation has contributed a theoretical-practical approach to the solution of technological problems. His recognition in education was established through the accreditation of technical institute-type programs by the Engineers' Council for Professional Development. His participation in the aviation industry has been of importance but has been in the traditional terminology of the engineering department.

The engineering technician will continue to play an important role in aviation. He should continue to gain more recognition in industrial terminology. His major personal problem will be one of status particularly as it relates to degree consciousness. Both the engineering technician and the technical institute should attain a well defined position in aviation in the near future.

Microfilm \$3.90; Xerox \$13.75. 303 pages.

### ENGINEERING, AGRICULTURAL

#### OPTIMIZING MATERIALS HANDLING SYSTEMS BY MATHEMATICAL PROGRAMMING

(L. C. Card No. Mic 60-4200)

Robert McDermand Peart, Ph.D.  
Purdue University, 1960

Major Professor: G. W. Isaacs

The problem of selecting equipment and methods and organizing them into an efficient materials handling system



is important in agriculture. The current trend toward specialization, mechanization and automation is speeding changes in farm materials handling systems. Many research workers have noted the need for considering the entire system and its inter-relationships rather than selecting equipment and methods on the basis of only one process.

The purpose of this study was to construct mathematical models of the systems that could describe these relationships, and to apply or develop mathematical programming methods for optimizing the system. Work in the field of operations research, especially linear programming, was studied. Known methods were applied and new methods were developed for solving three types of system selection problems.

A flow chart of alternative methods was used to present the possibilities, and it was constructed so a single path through the chart represented a complete materials handling system.

The simplest type of problem studied is called the "minimum-path" type. The requirement is that each method, represented by one link in the flow chart, must have a constant criterion value regardless of what other methods are combined with it in a complete system. The solution methods select the system with the minimum value of the criterion which may be cost, time, energy, etc. Application was made of known mathematical programming methods including the general model, the assignment model, and the transshipment model of linear programming; the "tree" method; the "optimal path method;" and the analog method. Since the analog method required a special electrical analog computer, it was less desirable than the other methods, which used a general-purpose digital computer.

The second type of problem, called the fixed-size, multiple-use problem, is that of selecting the minimum-cost system for a fixed-size materials handling operation with possibilities of using certain machines in none, one, or more than one process. A new linear programming model, called the unit-flow model, was developed for solving this problem. The amount of material to be handled by any one method was defined as one unit, and the flow chart was viewed as a network carrying a total flow of one unit.

Each link or method was represented by a variable equal to the number of units handled by the method, and each multiple-use machine was represented by a variable equal to the number of the machine used or purchased. Solutions for these "purchase" variables were desired to be in integers (either zero or one, in this case). Although there were possibilities for exceptions in unusual cases, the unit-flow model yielded zero or unity values in all problems solved, including one actual farm situation with 82,944 possible systems. It was concluded that this method is a useful and unique tool for solving this common type of materials handling problem.

Extra restrictions, such as labor or capital limitations, on the fixed-size problem generally caused non-integer solutions to the unit-flow model. For such problems, recently-developed methods of finding integer solutions to linear programs were recommended.

The third type of problem also made use of integer-solution methods. It is called a variable-size problem. It is the problem of selecting levels of various farm enterprises and the materials handling system, so that the net

returns are maximized. The model was constructed with variables for enterprises, materials handling methods, and machine purchases. Restrictions included network and purchase constraints, as well as the usual resource constraints of an enterprise selection problem.

The applications of the models using integer-solution methods depend on recently-established theory, and a computer routine was not yet available at the time of this research. It was concluded that with the expected computer program for integer solutions to linear programs, future research can make effective use of these models.

Microfilm \$2.50; Xerox \$7.60. 161 pages.

## ENGINEERING, CHEMICAL

### BUBBLE GROWTH IN NUCLEATE BOILING OF A BINARY MIXTURE

(L. C. Card No. Mic 60-3880)

James Edwin Benjamin, Ph.D.  
University of Illinois, 1960

Boiling bubble growth rates in mixtures of water and ethylene glycol were measured at 1 atmosphere. Boiling took place from a 0.004 inch diameter artificial nucleation site in a vertical copper surface at 4, 8, and 18 degrees centigrade superheat. Measurements were made from movies taken with a high speed camera through a metallographic microscope. The movies were made with 3 diameters magnification at 5,000 frames per second using a D. C. arc for light. The resulting diameter and time measurements were fitted by a digital computer to an equation of diameter proportional to time raised to an exponent. The exponents range from 0.08 to 0.81 and the coefficients from 0.15 to 26.8. Plots of the coefficient versus liquid concentration are in general agreement with Scriven's theoretically predicted curves which show a minimum around 0.04 mass fraction water in ethylene glycol. Microfilm \$2.50; Xerox \$5.00. 96 pages.

### PHASE EQUILIBRIA OF THE PROPANE-HYDROGEN SULFIDE SYSTEM FROM THE CRICONDENTHERM TO THE SOLID-LIQUID-VAPOR LOCUS

(L. C. Card No. Mic 60-4493)

Jerome Brewer, Ph.D.  
University of Kansas, 1960

The presence of hydrogen sulfide in propane or in other hydrocarbons is objectionable. At present it is removed by the expensive process of scrubbing and it may be profitable to make the separation by physical means at low temperatures. To evaluate such processes, this study was initiated to investigate the phase equilibria of the propane-hydrogen sulfide system from the cricondentherm

down to the solid-liquid-vapor region and to verify the work of other investigators at the higher temperatures.

The dew-and-bubble-point method was used in which the gas sample was contained in a glass equilibrium cell of constant volume and immersed in a constant temperature bath. The contents were stirred with a steel ball which was raised and lowered by means of a manually-operated magnet. Gas was admitted to the cell in measured increments from a high pressure source, so that as the pressure was raised the system passed successively and isothermally through the states of superheated vapor, saturated vapor, mixed vapor and liquid, and finally saturated liquid.

The crude hydrogen sulfide was partially purified by a series of batch distillations near the dry ice point. The purified components were estimated to be at least 99.9% pure. The analyses of the gas mixtures were determined by gas density measurements.

The phase equilibria of five mixtures of the propane-hydrogen sulfide binary were determined from the crycondentherm to the three-phase region from 1033 to 0.85 lb./sq. in. abs. and from 189.4°F. to -156.1°F. A miscibility gap was not found in any of the mixtures studied. Minimum-boiling azeotropes were found in mixtures of 8.0% to 41% propane from 400 to 20 lb./sq. in. abs., in a temperature range from 99°F. to -96°F. The original experimental data were presented in phase behavior curves of the vapor-liquid region in which the pressure was plotted against the volume per cent liquid for six isotherms from 140°F. to -100°F. Altogether six mixtures were studied ranging from 8.6% to 78.3% propane. Comparisons of the dew point data of this study with those of Kay and Rambosek were shown in semi-logarithmic plots. The agreement was excellent. Consistency was indicated by the fact that straight lines could be drawn through most of the data points for each mixture down to temperatures near -100°F.

For each mixture the data were also presented in pressure-temperature diagrams from the critical points to the three-phase region. The phase border curves of the propane-hydrogen sulfide binary were presented including the three-phase and the critical loci. The three-phase locus was found to be nearly a straight line terminating at the triple points of propane and hydrogen sulfide. A composite temperature-composition diagram was presented from the cross-plotting of the pressure-temperature diagrams for each mixture at isobars from 400 to 20 lb./sq. in. abs. Vaporization equilibrium constants were calculated and tabulated for these isobars together with the x-y data. The location of the azeotropes were determined by plotting the difference between the dew and bubble point pressures as a function of pressure. Fairly sharp minima were obtained, marking the temperature and composition of the azeotropes.

It is estimated that the data in the vapor-liquid region agreed with those of the other investigators within 2% over most of the range. It was shown that the azeotrope locus of this study was found to lie between that of Steckel, and Kay and Rambosek. The vapor and liquid compositions in the solid-liquid-vapor region was presented. A measure of the reliability of the composition, temperature, and pressure data of the solid-liquid-vapor region was indicated when checks within 5% were found with Dalton's law of partial pressures.

Microfilm \$2.50; Xerox \$7.60. 163 pages.

## VAPOR-LIQUID EQUILIBRIA OF AQUEOUS SYSTEMS CONTAINING AMMONIA AND CARBON DIOXIDE

(L. C. Card No. Mic 60-3497)

Gerhard J. Frohlich, D.Ch.E.  
Polytechnic Institute of Brooklyn, 1957

Adviser: Dr. D. F. Othmer

The object of this research was to develop an aqueous solution of ammonium nitrate as a separating liquid for partial absorption of  $\text{NH}_3$  from a gaseous mixture with  $\text{CO}_2$  since preliminary considerations indicated that this solution would have preferential absorption for  $\text{NH}_3$  in a gas scrubbing system. In order to obtain design data for such operation, data were needed for the vapor-liquid equilibria on the binary systems  $\text{NH}_3$  and  $\text{H}_2\text{O}$ , also on  $\text{H}_2\text{O}$  and  $\text{NH}_4\text{NO}_3$ , and on the ternary systems  $\text{NH}_3$  and  $\text{H}_2\text{O}$  and  $\text{NH}_4\text{NO}_3$ , also on  $\text{CO}_2$  and  $\text{NH}_3$  and  $\text{H}_2\text{O}$ . These binary and ternary systems established boundary conditions for the quaternary system  $\text{CO}_2$  and  $\text{NH}_3$  and  $\text{H}_2\text{O}$  and  $\text{NH}_4\text{NO}_3$  which would be the complex aqueous solution in a scrubbing tower.

The partial pressure of water above ammonium nitrate solutions was determined up to 60 weight percent  $\text{NH}_4\text{NO}_3$ . These data were combined with the vapor pressure and enthalpy data available in the literature to obtain a general vapor pressure correlation which covers the temperature range from 0°C up to 130°C and the concentration range from 0 to 90 weight percent  $\text{NH}_4\text{NO}_3$ . The activity of water and differential heats of solution for ammonium nitrate solutions were calculated. The activity coefficient of water is greater than one calculated on the assumption of complete ionization of the ammonium nitrate.

The Henry Coefficient for ammonia in water at infinite dilution was obtained from the total pressure of the system at low ammonia concentrations. For this determination and others below, a new experimental unit was designed and built of stainless steel; and a new technique of liquid-gas contacting under pressures up to several hundred pounds per square inch was developed.

The Henry Coefficient at infinite dilution was derived from thermodynamic considerations from the total experimental pressure. The Henry Coefficient in the temperature range from 90° to 150°C was determined. The slope of the line agrees with the experimental heat determination in the literature for the system  $\text{NH}_3$  and  $\text{H}_2\text{O}$ .

Total and partial pressure data were determined for the system  $\text{NH}_3$  and  $\text{H}_2\text{O}$  at 90°C, 120°C, and 150°C with ammonia concentrations up to 20 moles  $\text{NH}_3$  per kg. of water. The calculated activity coefficients for ammonia in solution are in satisfactory agreement with the latest literature data. These determinations proved the adaptability and accuracy of the equipment and operation for this determination.

The influence of ammonium nitrate on the activity of ammonia was then studied for aqueous solutions. Determinations were made in a concentration range up to 18 moles  $\text{NH}_4\text{NO}_3$  per kg. of water and up to 15 moles  $\text{NH}_3$  per kg. of water at 90°, 120° and 150°. At all temperature and concentration levels there is a decrease in partial pressure of ammonia out of the solution when ammonium nitrate is dissolved. Literature data at 10° and 35°C and the data of this investigation at 90°C, 120°C and 150°C



were correlated satisfactorily as activity coefficients versus ionic strength.

Vapor liquid equilibria for these solutions also containing carbon dioxide were determined at 60°C, 90°C, 120°C and 150°C in the new equipment. The vapor liquid equilibrium was expressed in terms of 4 equilibrium constants: that for the Henry Coefficient for aqueous ammonia, that for the ammonium bicarbonate equilibrium, that for the carbamate equilibrium and that for the ammonium carbonate equilibrium. The relation of the equilibrium constant which represents the bicarbonate equilibrium to ionic strength was determined at temperatures of 150°C, 120°C and 90°C from experimental data; and at 60°C from experimental data and from data published in the Russian literature. An expression which was derived from the Debye-Huckel-Bronsted Equation for the activity coefficient of an electrolyte was found to represent the dependence of the bicarbonate equilibrium constant up to an ionic strength of 10 moles per kilogram ( $H_2O + NH_4NO_3$ ). The empirical constant in the Debye-Huckel-Bronsted Equation was correlated with temperature. The equilibrium constant for the carbamate formation was calculated from experimental data and correlated with temperature. The equilibrium constant for carbonate formation was calculated using the Debye-Huckel Equation.

With the established equilibrium constants, partial pressures of carbon dioxide and ammonia were calculated and plotted against the temperature covering the range between 90°C and 150°C. The relative volatility of carbon dioxide to ammonia was computed and correlated as a function of the ammonium nitrate concentration and the temperature. (Relative volatility in this case takes into account the chemical equilibria in the liquid state as well as the physical equilibrium between the liquid and vapor states.) This relative volatility is increased by increasing the ammonium nitrate concentration and increasing the temperature. Pinch point compositions are determinable from the correlations. For total ammonia concentration in the solution of more than 4 moles of  $NH_3$  per kg. ( $H_2O$  and  $NH_4NO_3$ ), hardly any appreciable separation can be obtained below 120° and below an ammonium nitrate concentration of 10 moles per kg.  $H_2O$ .

From the data obtained, the desired characteristics of the wash liquor for separation of  $NH_3$  from a gaseous mixture with  $CO_2$  may be seen. It is always desired that the maximum amount of ammonia be absorbed from the gas stream by the wash liquor and the gas stream will pass overhead with a minimum of ammonia therein. The liquor stream containing the ammonia then passes out the base of the absorber and thence to a regeneration stripper wherein the ammonia is desorbed by heat. Thus, the higher the ammonia concentration which can be obtained at the base of the absorption column, the less absorption liquid will have to be recycled; but at the same time it is necessary that there be a low  $CO_2$  concentration at the bottom of the absorption tower liquid. Since these two effects are somewhat contradictory, it is necessary to find the optimum separation which may be obtained by study of the temperature and the ammonium nitrate concentration; and in the usual case, this separation is better at higher temperatures and higher ammonium nitrate concentrations.

Microfilm \$3.15; Xerox \$11.05. 242 pages.

# A KINETIC STUDY OF THE REACTIONS OCCURRING IN THE GLASS PREPARATION PROCESS

(L. C. Card No. Mic 60-3935)

Elwin Leroy Johnson, Ph.D.  
University of Illinois, 1960

The progress of reactions occurring in the process of glass preparation was followed by thermogravimetric analysis and quantitative x-ray diffraction analysis. Three soda-lime-silica compositions and one soda silica composition were studied. The reaction studies were carried out on individual crucible melts.

The process of silica lattice breakdown was identified as the rate-controlling process in the soda-lime-silica compositions. The process of sodium metasilicate (an intermediate reaction product) solution into the melt phase was identified as the rate-controlling process in the soda-silica composition studied.

The sequence of reactions in the  $Na_2CO_3$ - $CaCO_3$ - $SiO_2$  system at temperatures above the liquidus of the oxide composition, was as follows: (a) decomposition of calcium carbonate; (b) simultaneously with (a), sodium carbonate was melting, decomposing, and reacting with silica; (c) calcium oxide from (a) reacted with silica and melt to form soda-lime-silica melt and a small amount of calcium metasilicate; and (d) the soda-lime-silica melt reacted with the remaining silica to yield a crystal-free glass batch. The time required to complete reactions (a), (b), and (c), was extremely short as compared with the time required for the completion of (d), the process of dissolving the residual silica grain into the soda-lime-silica melt.

The sequence of reactions in the  $Na_2CO_3$ - $SiO_2$  system at the temperatures above the liquidus of the oxide composition, can be listed as follows: (a) the reaction between  $Na_2CO_3$  and  $SiO_2$  producing carbon dioxide and crystalline sodium metasilicate was sustained to completion; (b) the sodium metasilicate from (a) reacted with the remaining silica to form the first melt phase; and (c) the soda-silica melt from (b) reacted with the  $Na_2SiO_3$  and  $SiO_2$  to produce a crystal-free glass.

The specific reaction rates of the calcium carbonate decomposition in the soda-lime-silica batch were determined by applying the first-order rate equation to the reaction data. The specific reaction rates were used in calculating the activation energy of the decomposition process. The calculated activation energy is 105 kcal per mole. The same procedure was followed in calculating the activation energy of the reaction between sodium carbonate and silica in the soda-silica batch. However, in the sodium carbonate-silica reaction the second-order rate equation was employed in calculating the specific reaction rates of the process. The calculated activation energy for this reaction is 97 kcal per mole. The activation energies calculated for the above two processes were in good agreement with those reported in the literature from other methods of analysis.

The results of this study indicated that quantitative x-ray diffraction analysis is a very useful tool not only in following the progress of the reaction behavior of silica, but also in following the other solid-solid, solid-liquid, and solid-gas reactions in the glass preparation process.

Microfilm \$2.50; Xerox \$4.00. 71 pages.

# THE STUDY OF THE REACTION KINETICS OF THE DEHYDROGENATION OF CYCLOHEXANE TO BENZENE USING A PLATINUM CATALYST

(L. C. Card No. Mic 60-4771)

William Cyrus Kuby, Jr., Ph.D.  
Northwestern University, 1960

By studying the catalytic kinetics of the dehydrogenation of cyclohexane to benzene over a platinum-on-alumina catalyst, an attempt was made to obtain a rate equation based on a simple reaction model. It was found that the data would not fit any such rate equation. Through an investigation of the trends indicated by the data, it was felt that a combination of two steps in the reaction process was controlling. The result of this would be a blocking of the active catalytic sites and subsequent reaction rate reduction greater than would be expected.

Since no semi-empirical rate equation could be obtained, an empirical equation was determined. It follows:

$$X_A = \frac{\left(\frac{W}{F}\right)}{k_1} \left\{ \text{Log } T - p(\pi) e^{\left[\left(\frac{W}{F}\right)(k_2\pi + k_3)\right]} \right\}$$

where  $p(\pi)$  is an empirical function of pressure:

$$k_1 = 0.5041$$

$$k_2 = -0.00081142$$

$$k_3 = 0.06237938$$

This equation is good for a hydrogen to hydrocarbon ratio of 2:1 and up to conversions of 0.003 moles cyclohexane converted/gram feed. The pressure range is 100 to 500 psig and temperature range of 650 to 800 F. The maximum  $\left(\frac{W}{F}\right)$  investigated was 0.09 hrs. Also presented is an equation for correcting for changes in the hydrogen to hydrocarbon ratio and an explanation of its use.

Some description of the equipment specifically designed for this study and an outline of the general theory and procedure for such a study are included.

Microfilm \$2.50; Xerox \$4.60. 89 pages.

# A STUDY OF VELOCITY DISTRIBUTIONS AND RHEOGRAMS FOR LAMINAR PIPE FLOW OF PSEUDOPLASTIC FLUIDS

(L. C. Card No. Mic 60-3726)

Paul Henkle McGinnis, Jr., Ph.D.  
North Carolina State College, 1960

Supervisors: Frances Marian Richardson and  
Kenneth Orion Beatty, Jr.

The laminar flow behavior of selected pseudoplastic fluids was investigated by use of an observational technique which allows analysis of this behavior without a prior knowledge of the shear characteristics of a fluid. All experimental work was carried out for laminar flow in a horizontal, 1/2 inch inside diameter conduit within the average fluid velocity range 0.100 to 1.000 ft./sec.

The fluids used in this research were 0.50 and 1.00 per cent aqueous carboxymethyl cellulose (CMC-7HSP) solutions and 0.15, 0.20, and 0.30 per cent aqueous neutralized carboxypolymethylene (Carbopol-934) solutions.

A dye tracer displacement technique was used for the experimental determination of velocity distributions for each fluid. Shear rates within a flowing fluid were determined by numerically differentiating the experimental velocity distributions. The corresponding shear stresses were determined by writing a force balance for a differential element of flowing fluid. All shear rates were less than 250 sec.<sup>-1</sup> while the maximum shear stress obtained was 1.319 lbf./sq. ft.

Velocity distributions and rheograms (shear stress-shear rate relationships) were also predicted from a series of pressure drop and flow rate measurements for each fluid. Predicted results for the 0.30 per cent Carbopol-934 solution indicated a yield stress (a finite stress that must be exceeded in order to initiate flow) of 0.280 lbf./sq. ft. Distributions and rheograms for the remaining fluids were of the power-law type and the range of conventional power-law exponents was 0.542 and 0.667.

The agreement between the predicted and experimental rheograms indicated that, for a given value of shear stress, the shear behavior of each fluid was independent of radial position. From a comparison of experimental and predicted velocity distributions, there was no evidence of a slippage of the fluids at the conduit wall.

Microfilm \$2.60; Xerox \$9.00. 197 pages.

# REACTIONS OF ZIRCONIA AND TITANIUM AT ELEVATED TEMPERATURES

(L. C. Card No. Mic 60-4256)

Robert Ruh, Ph.D.  
Rutgers University, 1960

Major Professor: Dr. Robert B. Sosman

The reactions between zirconia and titanium have been studied by (1) weight change and bulk density determinations, (2) metallographic and petrographic analysis, (3) microhardness studies, (4) lattice parameter measurements, and (5) electron probe analysis. The following compositions were studied: ZrO<sub>2</sub>, ZrO<sub>2</sub> + 0.5, 1, 3, 5, 15, 30, 50, 70, 90 and 95 atomic % Ti, and Ti. Firings were accomplished in vacuum in the temperature range 1200-2000°C.

The weight before and after firing was recorded since titanium vaporizes rapidly at the temperatures employed. Results revealed that as the titanium content was increased, the weight loss was constant up to 3-5 atomic %, and then it began to increase. Thus, below 3-5 atomic % the titanium was tied up in solid solution. Above this percentage the solubility limit was exceeded and the excess metal was free to vaporize. Bulk density data supported this hypothesis.

Starting with ZrO<sub>2</sub> and moving across the binary, compositions were examined metallographically and petrographically. The first appearance of a metal phase was noted at the ZrO<sub>2</sub> + 5 atomic % Ti composition. This is evidence that slightly less than 5 atomic % Ti is retained



in solid solution in zirconia. With increasing titanium content, the amount of metal phase increased, and the amount of oxide phase decreased up to 90 atomic % Ti. In the composition  $\text{ZrO}_2 + 95$  atomic % Ti, only the metal phase was observed, indicating that the solubility of  $\text{ZrO}_2$  in Ti at room temperature is between 5 and 10 molecular %.

Examination of thin sections revealed that zirconia was translucent and as titanium was added, the material became more and more opaque. The composition  $\text{ZrO}_2 + 5$  atomic % Ti was completely opaque. This is additional evidence of titanium solid solution in zirconia.

Diamond pyramid hardness of the zirconia and titanium phases was determined with a Bergsman microhardness tester. Results on the zirconia phase revealed that the hardness increased as titanium was added up to 5 atomic %. For greater titanium contents, the hardness of the zirconia was essentially constant. Data also indicate the existence of a single-phase region up to 5 atomic % titanium at room temperature. Above 5 atomic % the solubility limit is exceeded and a two-phase region results.

The hardness of the titanium phase increased markedly as  $\text{ZrO}_2$  was added up to 10 molecular %. Beyond this point the hardness was essentially constant. This indicates the existence of a single-phase region up to 10 molecular %  $\text{ZrO}_2$  at room temperature. Above this value the solubility limit is exceeded and a two-phase region exists.

Precision lattice parameter determinations were made on both zirconia and titanium. For zirconia, parameters were determined for a raw and fired mixture of  $\text{ZrO}_2 + 15$  atomic % Ti. Changes between the two were small and did not give positive evidence of the existence or nonexistence of titanium solid solution in zirconia.

The lattice parameters of titanium were determined on fired mixtures of the compositions:  $\text{ZrO}_2 + 30, 50, 70, 90$ , and 95 atomic % Ti, and Ti. Results revealed that both the *a* and *c* parameters steadily increased with zirconia additions up to 10 molecular %. The *c/a* ratio also was increasing up to 10 molecular % zirconia. As greater amounts of zirconia were added, the *a* and *c* parameters and the *c/a* ratio remained relatively constant. This indicates that up to 10 molecular %  $\text{ZrO}_2$  is retained in solid solution in Ti.

Electron probe analysis was made on two samples,  $\text{ZrO}_2 + 5$  atomic % Ti fired to  $2000^\circ\text{C}$  and  $\text{ZrO}_2 + 90$  atomic % Ti fired to  $1700^\circ\text{C}$ . Analysis of the zirconia phase indicated the presence of a small amount of titanium. Analysis of the titanium phase indicated the presence of a large amount of zirconium.

In summary, a considerable body of evidence indicates that up to approximately 4 atomic % titanium is retained in solid solution in zirconia. At the other end of the phase diagram, data indicate that zirconia contents up to 10 molecular % are retained in solid solution in titanium. In this case the zirconium goes into the titanium substitutionally and the oxygen goes in interstitially.

Microfilm \$2.50; Xerox \$5.60. 112 pages.

# HIGH PRESSURE HYDROGENATION OF COTTONSEED OIL: EFFECT OF VARIABLES AND KINETICS OF THE REACTION.

(L. C. Card No. Mic 60-4226)

Jaime Wisniak Marcovich, Ph.D.  
Purdue University, 1960

Major Professor: Lyle F. Albright

Cottonseed oil was hydrogenated in a batch-scale dead-end reactor at relatively high pressures (150 to 1,500 psig) and at such high rates of agitation that mass transfer resistances were essentially eliminated. Runs were made over the following ranges:

1. Temperature, 100 to  $135^\circ\text{C}$ ,
2. Pressure, 150 to 1,500 psig,
3. Catalyst concentration, 0.02 to 0.15% nickel by weight, in order to determine the effect of these operating variables on the rate of hydrogenation, isomerization, and selectivity of hydrogenation. Oil samples were taken during the course of the reaction and analyzed using the latest techniques of gas-liquid chromatography and infrared spectroscopy.

The principal findings of this research are as follows:

1. The over-all rate of hydrogenation was directly proportional to the temperature and varied linearly with catalyst concentration, as long as mass transfer resistances were negligible and the activity of the catalyst remained the same. The rate was also approximately proportional to the 0.58 power of the absolute pressure.
2. Selectivity and isomerization were unaffected by changes in catalyst concentration, as long as the catalyst activity remained the same and mass transfer effects were negligible.
3. Selectivity and isomerization decreased with increased operating pressure.
4. Selectivity was not significantly affected by increased temperature when mass transfer resistances were eliminated. Isomerization, however, was slightly favored by higher temperatures.
5. A quantitative measurement of selectivity and isomerization is possible through the use of a proposed reaction mechanism. A selectivity number *N* is defined as the ratio of the relative reaction rate constants for the conversion of linoleic acid to oleic acid and for the conversion of oleic acid to stearic acid. *N* was found to decrease from 4.7 at 150 psig to 2.4 at 1,500 psig.
6. A hydrogenation mechanism has been proposed and tested quantitatively. The controlling step is probably the reaction between atomically chemisorbed hydrogen and unsaturate in the liquid phase. The heat of dissociation of hydrogen on the catalyst used is estimated to be about 27.1 Kcal/g mole.
7. Hydrogen solubilities in cottonseed oil were determined at  $125^\circ\text{F}$  to  $283^\circ\text{F}$ , from 150 to 1,500 psig. The solubility of hydrogen increases with temperature, and at pressures of the order of 1,500 psig the mole fraction of hydrogen in the oil was in excess of 20%. The following empirical equation has been developed to predict the experimental solubilities determined, to within  $\pm 5\%$ :

$$S = -7.330 \cdot 10^{-2} + 2.208 \cdot 10^{-3} P + 1.732 \cdot 10^{-5} PT - 2.952 \cdot 10^{-8} PT^2 - 2.924 \cdot 10^{-7} P^2$$

where

$S$  = ml hydrogen S.T.P./g oil

$P$  = psia

$T$  = °F

Microfilm \$2.50; Xerox \$6.40. 131 pages.

## ENGINEERING, CIVIL

### A STUDY ON THE CONSOLIDATION OF MEXICO CITY CLAY

(L. C. Card No. Mic 60-4168)

Pablo Girault, Ph.D.  
Purdue University, 1960

Major Professor: Dr. G. A. Leonards

This investigation was initiated in an attempt to obtain a better understanding of the time-rate of compression of saturated, fine-grained soils.

Consolidation tests were conducted on undisturbed and remolded samples of Mexico City clay, and for comparison purposes on remolded limestone residual (Bedford) clay and silty, glacial (Crosby B) clay. Measurements of pore pressure and side friction force were made for a wide range of load increment ratios (0.05 to 3.0) and various side-wall treatments of the consolidometer rings, including greased, teflon linings. Direct permeability tests were also conducted.

The pore water in the undisturbed and remolded Mexico City clay was replaced with carbon tetrachloride in order to study the influence of polar molecules in the pore fluid on the rate of secondary compression.

To assist in the interpretation of the results obtained, some mathematical solutions to the Theory of Consolidation are presented dealing with certain initial excess pore pressure distributions, time-dependent loadings, and consolidation with variable coefficient of consolidation.

The principal conclusions are:

- a) Dial reading-time curves can be classified according to three typical shapes depending on the ratio of the rate of secondary compression to primary consolidation. This latter ratio is essentially controlled (for any given initial conditions) by the magnitude of the loading increment ratio.
- b) Secondary compressions cannot be attributed to viscous drag (or other mechanisms) associated with the orientation of polar molecules around clay particles, although the rate of secondary compression is influenced by this factor.
- c) Side-friction forces can have large effect on the rate of pore pressure dissipation measured in consolidation tests unless greased, teflon-lined consolidometers are used with a diameter to height ratio greater than (approximately) six.
- d) the rate of pore pressure dissipation takes place in

accordance with the Terzaghi theory only if large load increment ratios are used (greater than two for Mexico City clay). If the load increment ratio is small, the Terzaghi theory can not predict, even approximately, the rate of pore pressure dissipation.

Microfilm \$2.80; Xerox \$9.70. 215 pages.

### FLEXURAL ELASTIC CHARACTERISTICS OF CROSS-SHAPED STRUCTURAL JOINTS

(L. C. Card No. Mic 60-3403)

Shantilal Chaturbhai Patel, Ph.D.  
Michigan State University, 1959

Major Professor: Carl L. Shermer

A knowledge of the energy distribution characteristics of the joints is important for an analysis of indeterminate framed structures with deep-short members. This dissertation determines the characteristics of cross-shaped joints (internal joints of the framed structure) subjected to flexural action. The members of the frame are of rectangular cross section and the stress distribution is assumed to be plane.

The Airy's stress function  $\phi$  inside the cross-shaped region is determined by solving the biharmonic differential equation by the numerical finite difference method. The stresses and the elastic energy per unit beam length are determined. The equivalent depth distribution is calculated, i.e., the depth distribution which when used in the evaluation of the energy by the conventional beam theory formulas will give the true elastic energy. The effects, of the fillets at the joint, of the dimensions of the cross shape, and of the variations in the Poisson's ratio, on the equivalent depth are studied.

The column portion of the cross shape is also analyzed with an assumed linear bending stress distribution and a uniform shear stress distribution at the beam to column junction. The analysis is made by taking the stress function in the form of a series. The comparison of equivalent depth curves, inside the column portion, calculated by the finite difference method and by the series method shows a fair agreement as far as the shape of the equivalent depth curve is concerned. The series method is also used to investigate the effect of the different proportions of the cross shape on the equivalent depth inside the column.

It is concluded that the exact value of the equivalent depth depends upon the proportions of the cross shape, the type of the loading, and the radius of the fillet. For practical use, an approximate equivalent depth line is suggested, which can be used for any kind of loading and any proportions of the cross shape. In an example, worked out with the suggested approximation and the beam theory formulas, the total energy of the joint differs from the energy calculated by the finite difference method by less than 11%. This is a much smaller error than that which results from using either of the assumptions commonly made: that the equivalent depth at any section inside the joint is the same as the depth at the face of the joint or alternatively that the moment of inertia at any section inside the joint is infinity. Either of these assumptions



leads to errors of about 100% in the total energy of the joint. Microfilm \$2.70; Xerox \$9.45. 208 pages.

### DYNAMIC BEARING CAPACITY OF FOUNDATIONS

(L. C. Card No. Mic 60-4005)

George Emmanuel Triandafilidis, Ph.D.  
University of Illinois, 1960

Usually the foundation engineer deals with live loads applied slowly enough to allow contact pressures ample opportunity to adjust themselves at all times to the superimposed stress level. An analysis of such problems involves the principles of statics. Occasionally the designer has to deal with cases where the dynamic effect of the superimposed loads cannot be neglected. Consequently, the foundation design must involve the principles of dynamics. Whenever the dynamic contribution is of minor consequence compared to the total static stress, it is considered adequate to provide an arbitrary additional equivalent static load in order to take into account the supplementary dynamic effect. Examples of this approach are the adoption of impact factors or the modification of safety requirements in order to provide safety against dynamic effects.

In recent years developments in nuclear weapons have led to the necessity of a more precise evaluation of the effects produced by transient loadings. As a result, the designer must consider dynamic loads of large intensities acting through relatively short durations.

On account of developments of techniques in structural dynamics, the design of the superstructure to resist time dependent loadings has already acquired a certain degree of refinement. Unfortunately the same cannot be said for the design of the substructure to resist dynamic loads because of the erratic, heterogeneous and in general intricate physical characteristics of the supporting natural medium.

A survey of the literature indicates that both analytical and experimental work directly pertinent to this subject matter is of limited extent. Nevertheless the necessity of formulating an approach for blast resistant foundation design becomes increasingly pronounced in view of developments in atomic weapons.

The general objective of this dissertation is therefore to develop an analytical approach for the dynamic bearing capacity of foundations. The approach is based on a number of simplifying assumptions which provide an expedient way of obtaining simple means to calculate the resulting angular rotations as function of time. For design purposes the entire history of the motion is of no particular interest. The designer is mainly concerned in the peak angular rotations. Charts have been obtained that enable the designer to calculate readily the maximum angular rotations  $\theta_{max}$ , provided the relation between time and the intensity of the dynamic pressure  $p_t$  can be expressed by means of a simple mathematical relation. The differential equation of motion has been solved for both an initially peaked triangular pulse and a rectangular pulse.

The dynamic bearing capacity approach has further been simplified by restricting its application to cohesive

materials. Under these circumstances it can be assumed that failure in the field is likely to take place according to the  $\phi$  equal zero concept whereupon the shearing resistance of the foundation material is independent of the normal stress on the surface of failure. Although an analysis based on such assumptions can by no means be regarded as an exact solution of the dynamic bearing capacity problem, yet it serves a useful purpose if it provides a reasonable estimate of the order of magnitude of the deformations to be expected under time dependent loading conditions.

Microfilm \$2.50; Xerox \$4.80. 91 pages.

### THE INFLUENCE OF BLAST AND EARTH PRESSURE LOADINGS ON THE DYNAMIC RESPONSE OF FLEXIBLE UNDERGROUND TWO-HINGED ARCHES

(L. C. Card No. Mic 60-4011)

Worthen Allen Walls, Ph.D.  
University of Illinois, 1960

An analytical study was made of the loadings on underground circular-segment arches which would be produced both by the blast pressure of a nuclear weapon explosion, and by the passive earth pressure due to the deflection of the arch under the blast pressure load. After these loadings were defined, the dynamic flexural response of the arch rib was investigated by idealizing the arch-soil system as a single-degree-of-freedom system subjected to a time-dependent load. The flexural resistance of the arch rib per se was considered negligible in comparison to the resistance provided by the soil, and was disregarded.

The pressure induced in the soil by the blast pressure acting on the ground surface was conceived to act as a pressure wave whose propagation velocity was defined as a function of both the surface velocity of the air blast wave and the seismic velocity of the soil. At a specific point, the radial pressure acting on the arch was defined in terms of the horizontal and vertical pressure at that point. The time dependency of these pressures was related to the time dependency of the surface blast pressure. The effects of varying the seismic velocity of the soil, the ratio of the horizontal to the vertical pressure, and the time dependency of the pressure were studied.

After the pressure-time relations at a specific point were determined, the total radial load on the arch was found. This total radial load was expressed as a distributed load by the first three terms of the trigonometric

series  $\sum p_n(t) \sin \frac{n\pi\phi}{\theta}$ . The effect of this load on the

haunch was related to a uniformly distributed, time-dependent, analogous load acting inwardly on the windward half of the arch, and outwardly on the leeward half. The pressure-time diagram of this analogous load was defined by considering the pseudo static effects of the load

$\sum p_n(t) \sin \frac{n\pi\phi}{\theta}$  at various times. The analogous load

subsequently was used to define the time-dependent

load acting on the idealized single-degree-of-freedom system.

Rankine's passive earth pressure theory was used in determining the passive earth pressure acting on the arch rib. After the unit passive earth pressure acting on the arch was defined, the total radial load on the arch was

expressed as a distributed load  $\sum p_n \sin \frac{n\pi\varphi}{\theta}$ , which was

subsequently idealized as a uniformly distributed, analogous load acting inwardly on the leeward half of the arch and outwardly on the windward half. This analogous load defined the unit resistance of the arch and the idealized single-degree-of-freedom system.

After the loading and resistance functions were idealized, a limited investigation was made of the dynamic response of various-sized arches to the blast pressure originating from a one megaton nuclear weapon. The results were expressed quantitatively.

The major conclusions reached in this thesis were:

- (1) The relative severity of the dynamic loading on the arch varies directly with the seismic velocity of the soil and inversely with the ratio of the horizontal to the vertical pressure in the soil.
- (2) The dynamic response of the arch varies directly with the peak overpressure of the surface blast wave, and inversely with the radius and/or the central angle of the arch.
- (3) The passive earth pressure provides a significant resistance in the arch.

Microfilm \$2.50; Xerox \$6.40. 131 pages.

## ENGINEERING, ELECTRICAL

### SERVOMECHANISMS WITH FORCE FEEDBACK

(L. C. Card No. Mic 60-3876)

Robert Charles Arzbaeher, Ph.D.  
University of Illinois, 1960

The effect of positive force feedback on a linear, proportional, positional servomechanism is analyzed, using a second-order model. This type of feedback is shown to cancel the effect of a load disturbance on the behavior of the servomechanism. A vacuum-tube analog for the servomechanism is developed, with voltage and current analogous to velocity and force, respectively; then, nullifying the effect of load forces on the behavior of a servomechanism becomes simply a matter of lowering the output impedance of the analog. Bode's results on the effect of feedback on vacuum-tube circuit impedances are readily applied to the analog, and current (force) feedback is shown to offer a promising means for lowering output impedance and thus making the response insensitive to external loads. Experimental evidence is presented in support of the analysis.

The effect of deflection in the force transducer is also analyzed, when an inertial load is assumed. It is shown that the spring-mass combination of the transducer-load undergoes sustained oscillation at its natural frequency

when force feedback is applied to the servomechanism. However, the amplitude of the oscillation can be made insignificantly small by making the force transducer stiff enough so that the period of oscillation of the transducer-load combination is much shorter than the rise time of the servomechanism.

When the nature of the load is purely inertial, force feedback becomes acceleration feedback, and a chapter is devoted to exploration of the effects of positive acceleration feedback on the stability and speed of response of a positional servomechanism. For a second-order model, analytical and experimental results are presented which demonstrate that positive acceleration feedback reduces the effective inertia of the servomotor and thus improves both damping and speed of response.

The mathematical model is extended to include third-order systems as well, and when the extra, third-order time delay is significant the use of positive acceleration feedback is shown to produce a great reduction in stability. Here, analog computer results are presented which demonstrate the oscillatory nature of a system with positive acceleration feedback when significant higher-order effects are present.

Two types of force-reflecting servomechanisms are also analyzed. These are systems which produce, at the input, a sense of feel of the load forces. Criteria for evaluating the systems mathematically are established and the application of these criteria shows the adverse effects on performance produced by the friction and inertia of the components. The use of velocity and acceleration feedback to compensate for friction and inertia is analyzed, as well as the use of negative force feedback. Just as positive force feedback is shown to lower the output impedance of a positional servomechanism, so also is negative force feedback shown to increase output impedance. When negative force feedback is applied around the input end of a force-reflecting servomechanism, the resulting increase in input impedance is manifested by an apparent reduction in inertia and friction, and thus an improvement in the sense of feel.

Laboratory models of both types of force-reflecting servomechanisms have been constructed, and the effect of force feedback in improving the sense of feel is described. Some quantitative measurements are given which verify the analytical results and offer evidence that the mathematical model (second-order) is a good representation of the physical model actually constructed.

Microfilm \$2.50; Xerox \$6.20. 128 pages.

### A STUDY OF REDUNDANT NUMBER REPRESENTATIONS FOR PARALLEL DIGITAL COMPUTERS

(L. C. Card No. Mic 60-3877)

Algirdas Anthony Avizienis, Ph.D.  
University of Illinois, 1960

In a parallel digital computer all digits of the representation of a number are made simultaneously available to the parallel arithmetic unit which performs the arithmetic operations of addition, subtraction, multiplication and division. Addition is considered as the basic operation



of the arithmetic unit, since subtraction of a number  $X$  can be performed as the addition of  $-X$ , while multiplication and division can be performed as a sequence of conditional additions and shifts.

If the conventional "positional, radix  $r$ " representation of numbers is used in a parallel digital computer, carry digits must be formed and propagated in serial manner. When all carries have been formed, all sum digits can be formed simultaneously, in parallel manner.

Storage of the carry digits has been the most fundamental approach to the elimination of carry propagation during arithmetic operations. Previous studies have developed the concept of redundant number representations and extended coincident carry-borrow storage throughout the entire computer, eliminating complete carry propagation before storage. In a redundant representation the digits may assume more than the  $r$  values  $(0, 1, \dots, r-1)$  which they assume in a conventional representation of the same radix  $r$ .

This investigation considers the use of redundancy in representing the individual digits of a number without the carry-borrow identification which has been used previously.

A totally-parallel mode of addition is postulated to be the required characteristic of a number representation. It is demonstrated that there exists a class of number representations, denoted as signed-digit representations, which permit totally-parallel addition. The signed-digit representations exist for all radices  $r \geq 3$ . A digit  $z_i$  assumes  $n$  values  $(r+2 \leq n \leq 2r-1)$  which form a sequence of integers. The sequence includes the values  $+2, +1, 0, -1, -2$ , and the absolute value of the digit  $z_i$  may not exceed  $r-1$ . The analysis and execution of arithmetic operations is simplest if the sequence of integers is chosen to be symmetric with respect to zero, that is, from  $+h$  to  $-h$ , where  $h \leq r-1$ . The representation then is a symmetric signed-digit representation. A symmetric minimal-redundancy signed-digit representation permits  $r_0+2$  values of a digit for an odd radix  $r_0 \geq 3$ , and  $r_e+3$  values for an even radix  $r_e \geq 4$ .

Procedures exist for the execution of the operations of shifting, addition, subtraction, multiplication and division for numbers in the symmetric, minimal-redundancy signed-digit representation.

The signed-digit representations possess a unique representation of the sign of the algebraic value of the number and a unique representation of the zero value. These properties are due to the maximum absolute value  $r-1$  of a digit in radix  $r$  signed-digit representation. This offers an advantage over previous redundant representations which permitted the maximum value of  $r$  of a digit.

The logical design of an adder is reduced to the logical design of a stage-adder for one digital position. The sum-digit output of a stage-adder is the function of two adjacent digits of the addend and the augend only. The complexity of a radix 4 stage-adder is about  $2\frac{1}{2}$  to 3 times greater than the complexity of one digital position in a conventional radix 4 adder.

Microfilm \$2.50; Xerox \$4.40. 84 pages.

## ANALYSIS OF PULSE-WIDTH MODULATED CONTROL SYSTEMS

(L. C. Card No. Mic 60-4746)

Francis R. Delfeld, Ph.D.  
Northwestern University, 1960

A pulse-width modulated control system is a sampled-data system in which the duration of each pulse is made proportional to the absolute value of the input quantity at the sampling instants. The amplitude of each pulse is constant, and its direction or sign is the same as the input quantity at the sampling instants. The pulse-width modulator which produces this pulse sequence is, in general, nonlinear; for sufficiently small inputs it may be approximated with a sequence of equivalent area impulses. This work is primarily concerned with the nonlinear aspects of pulse-width modulated control systems with a single nonlinear element (i.e., the pulse-width modulator) and a  $k$ th order linear plant.

The analysis techniques developed in this work may be classified as,

1. A method for determining the exact response of pulse-width modulated control systems to an arbitrary input.
2. A method for investigating the stability of pulse-width modulated control systems using modified describing functions.
3. A method for determining the exact open loop response of a pulse-width modulated control system to a periodic input.

Through use of the first method, the behavior of pulse-width modulated control systems in the time domain may be studied on an exact analytical basis. The modified describing function method provides a means for studying the behavior of pulse-width modulated systems using Nyquist diagrams and a critical locus which is dependent on the amplitude of the system error. The validity of the describing function representation may be verified by determination of the exact open loop response (at the sampling instants) for the periodic inputs being considered in the describing function investigation.

The method for determining the exact response of a pulse-width modulated control system is based on the exact difference equations relating the system output to the system error at the sampling instants. By defining auxiliary variables which are dependent on the system error and the linear plant, an equivalent nonlinear sampled-data system is obtained. Use of  $z$  transform theory provides a matrix method for determining the closed loop response of a  $k$ th order system to an arbitrary command.

A brief study of the direct describing function technique (i.e., describing function representation of the pulse-width modulator) shows that the describing function of the pulse-width modulator is dependent on the amplitude, frequency and phase of the sinusoidal input. A more convenient method, called the modified describing function method, is developed by utilizing describing functions for each nonlinear gain element in the equivalent nonlinear sampled-data system. Nyquist diagrams for each magnitude of the sinusoidal input provide a family of curves with which system stability may be studied by conventional

methods. The critical locus, as a function of system gain, is confined to the negative real axis.

The method for determining the exact open loop response to a periodic input is based on the exact difference equations of the system. The steady state system output at the sampling instants for a periodic system error is determined by defining auxiliary variables and use of z transform theory. The periodic system output is then expressed in a matrix equation in terms of the linear plant parameters and auxiliary variables which are uniquely determined by the specified system error and the linear plant.

Microfilm \$2.50; Xerox \$6.40. 135 pages.

#### AN INVESTIGATION OF A FAST WAVE RADIATOR

(L. C. Card No. Mic 60-4237)

Leonard Hatkin, Ph.D.  
Rutgers University, 1960

Major Professor: Sylvan Fich

The objective of the research described in this thesis is to determine the properties, characteristics, and the procedure for designing an antenna having currents and fields that are propagated with a phase velocity greater than that of light in vacuo. The technique of high phase velocity propagation seems to be applicable to situations which call for compact antennas having high efficiency or requiring the capability of electronic or electromechanical scan.

A theoretical survey of the nature and advantages of the high phase velocity antenna has been made. In this connection a single wire carrying a fast wave was analyzed. This analysis shows the increase in radiation resistance as a function of phase velocity.

A parallel plate strip antenna using various degrees of inductive shunt loading has been fabricated. Far field radiation pattern measurements, as well as near field, and bench attenuation measurements, have been made over the frequency ranges appropriate to the various structures. Relative phase velocity as calculated from the far-field pattern measurements agrees quite well with the relative phase velocity as determined from the near field measurements.

Analytical expressions for the phase velocity and attenuation have been set up and solved, both by using approximations and by programming the complete solution for the Burroughs 220 Computer. It is shown that, by using relatively straightforward approximations, values extremely close to the machine solution are obtained. The generalized Transverse Resonance Method is used in the theoretical analysis. The agreement between the measured and theoretical values of radiation patterns, relative phase velocity, and attenuation is good, particularly in the mid-design frequency range.

Some suggestions as to the practical employment of the advantages of the high phase velocity antenna are made.

Microfilm \$2.50; Xerox \$7.40. 159 pages.

#### ANALYSIS OF SOME STOCHASTIC PROCESSES ARISING FROM A LEARNING MODEL

(L. C. Card No. Mic 60-3663)

Laveen Kanai, Ph.D.  
University of Pennsylvania, 1960

Supervisor: Professor Robert R. Bush

This dissertation presents an analysis of some stochastic processes arising out of a learning model proposed by R. Duncan Luce for simple learning situations. The model, called the beta model by Luce, represents a major departure from most previous mathematical models for learning, in that response probabilities undergo nonlinear rather than linear transformations from trial to trial. This investigation is restricted to specializations of the beta model which appear to be of primary interest in empirical tests of the model.

If  $p_n$  is the probability of response  $A_1$  on trial  $n$  and  $(1-p_n)$  is the probability of response  $A_2$  ( $n = 1, 2, 3, \dots$ ), the class of models considered is characterized by the transformations:

$$p_{n+1} = \begin{cases} Q_1 p_n & \text{with probability } p_n \\ Q_2 p_n & \text{with probability } (1-p_n) \end{cases}$$

where

$$Q_k p_n = \frac{\beta_k p_n}{1 + (\beta_k - 1)p_n}, \quad k = 1, 2;$$

$$\beta_k \geq 0; \quad 0 \neq p_1 \neq 1.$$

The methods generally used to derive properties of linear learning models do not apply to the nonlinear beta model. The approach used in this dissertation is to consider the branching process defined by the decision rules of the beta model and from it, to formulate functional equations for various statistics of interest. The method is also applied to a linear commuting-operator model called the alpha model.

Chapters 1 and 2 are introductory in nature. Chapter 1 contains a brief sketch of the structure of stochastic models for learning and a derivation of Luce's beta model, while Chapter 2 defines three specializations of the model viz, the one-absorbing-barrier (OAB) model, the two absorbing-barrier (TAB) model, and the two-reflecting-barrier (TRB) model.

Functional equations for statistics of the OAB alpha and beta models are derived in Chapter 3. The functional equations for the OAB alpha model have the general form

$$y(p, \alpha_1, \alpha_2) = py(\alpha_1 p, \alpha_1, \alpha_2) + (1-p)y(\alpha_2 p, \alpha_1, \alpha_2) + z(p, \alpha_1, \alpha_2),$$

where  $0 \leq p \leq 1$ ;  $0 \leq \alpha_1 \leq 1$ ;  $0 \leq \alpha_2 \leq 1$ ;  $z(0, \alpha_1, \alpha_2) = 0$ ;  
 $z(1, \alpha_1, \alpha_2) \geq 0$ ;  $y(0, \alpha_1, \alpha_2) = 0$  and  $\lim_{p \rightarrow 1} y(p, \alpha_1, \alpha_2)$  is

finite. Most of the functional equations for the OAB beta model have the general form

$$f(v, \beta_1, \beta_2) = \frac{v}{1+v} f(\beta_1 v, \beta_1, \beta_2) + \frac{1}{1+v} f(\beta_2 v, \beta_1, \beta_2) + g(v, \beta_1, \beta_2),$$

where  $0 \leq v < \infty$ ;  $0 \leq \beta_1 \leq 1$ ;  $0 \leq \beta_2 \leq 1$ ;  $g(0, \beta_1, \beta_2) = 0$ ;

$\lim_{v \rightarrow \infty} g(v, \beta_1, \beta_2) \geq 1$ ;  $f(0, \beta_1, \beta_2) = 0$  and  $\lim_{v \rightarrow \infty} f(v, \beta_1, \beta_2) = \infty$ .



Solutions to these general functional equations are presented in Chapter 4 and bounds for some of the statistics are presented in Chapter 5.

The asymptotic distribution of response probabilities for the TAB beta model is obtained in Chapter 6 by solving the functional equation

$$f(v, \beta_1, \beta_2) = \frac{v}{1+v} f(\beta_1 v, \beta_1, \beta_2) + \frac{1}{1+v} f(\beta_2 v, \beta_1, \beta_2),$$

where  $0 \leq v < \infty$ ;  $\beta_1 > 1$ ;  $\beta_2 < 1$ ;  $f(0, \beta_1, \beta_2) = 0$

and  $\lim_{v \rightarrow \infty} f(v, \beta_1, \beta_2) = 1$ .

Functional equations for statistics which indicate how fast the asymptotic state is reached in the TRB beta model are derived in Chapter 7.

The results on stochastic properties of the beta model which are presented in this dissertation should be of help in evaluating the ability of the beta model to fit data obtained from a number of learning experiments and enable comparisons between it and previous models. The techniques presented in this dissertation are applicable to other stochastic models for learning.

Microfilm \$2.50; Xerox \$6.00. 123 pages.

#### ANALYSIS OF DUAL-MODE SERVOMECHANISMS

(L. C. Card No. Mic 60-4191)

Eugene Steven McVey, Ph.D.  
Purdue University, 1960

Major Professor: John E. Gibson

A dual-mode servomechanism is an automatic control system that combines two separate and distinct modes of operation in a manner that makes the over-all system superior to a system utilizing either of the modes alone. The particular mode of operation at any time is selected in a manner to make use of the best features of each mode under the given operating conditions and, if possible, to eliminate the undesirable features of each mode. The dual-mode system is the simplest and perhaps the most practical of the general class of systems called "multiple-mode systems." Although the term dual-mode applies to any system which combines two modes of operation, the system of primary interest in this thesis is one which combines a linear mode of operation for relatively small or medium amplitude inputs with a relay mode of operation for relatively large inputs.

The advantages of converting relay systems into dual-mode systems have been acknowledged for about a decade, however, few dual-mode systems have been built even on an experimental basis. Apparently, the reason for this is the lack of adequate theoretical understanding of the problem. This thesis partially fulfills the need for a theoretical understanding of dual-mode systems. A stability analysis method has been established by using the describing function method of analysis. Analysis equations are developed for a perfect system and then practical considerations are added one by one until the analysis includes all of the imperfections normally found in switches. It has been found that a stability problem may

exist even though two stable systems are combined using perfect switches. Experimental systems have been built to experimentally prove the stability analysis method and to check the physical validity of the models assumed for the theoretical developments. The stability analysis has been applied to a general multiple-mode system to show how systems with "n" modes of operation are analyzed.

Earlier work in this area established mode boundaries using the solution time criterion. The optimum boundary in this sense is an ellipse. The concept of optimizing the over-all system response using a general performance index is introduced here for the establishment of optimum mode boundaries. It has been shown that the optimum mode boundaries for some typical systems can be approximated by straight line functions of error and error rate. It is possible to determine how much any mode boundary deviates from the optimum in numerical terms using the performance index. Practical application of the performance index method requires the use of an analog computer.

The interdependence of the mode boundary amplitude and the characteristics of a simplified relay switching boundary has been worked out for a second order system. Design equations are presented. A procedure is presented for the extension of the method to higher order systems by using an analog computer.

An experimental system has been constructed and tested with various inputs including random noise.

Microfilm \$2.50; Xerox \$7.60. 164 pages.

#### A THREE-DIMENSIONAL ADAPTIVE CONTROL SYSTEM

(L. C. Card No. Mic 60-4211)

Arthur Jackson Schiewe, Ph.D.  
Purdue University, 1960

Major Professor: G. R. Cooper

A three-dimensional self-adaptive process is described in which the rise time, overshoot, and gain of a control system are simultaneously controlled. With this degree of adaption, acceptable performance should be maintained for wide variations of environmental conditions. The three performance indices are applicable regardless of the order of the control system, but only the second-order system is considered in any detail in this thesis. The philosophy of the self-adaptive process is to first measure the impulse response of the control system, under operating conditions, and then, from this measurement, to generate three control (or error) signals which are proportional to deviations in the three performance indices from their desired values. On the basis of these deviations, the controllable parameters of the control system are continuously adjusted to restore the performance indices to their desired values.

A complete description of the measurement process, which is based upon crosscorrelation techniques, is presented. The method involves the utilization of a wide-band random, or pseudo-random, source to continuously provide excitation at the input to the control system. The output of the system is then multiplied by a delayed version of this excitation signal. The average value of the

resultant product is shown to be the value of a point on the impulse response (under appropriate restrictions on the excitation). It is shown to be possible to use periodic excitation, a pseudo-random signal, in order to remove the difficulties normally encountered in continuously generating noise with stationary statistics. Some reduction in the uncertainty associated with the average value is also obtained.

A simple method of generating mutually independent control signals is presented. It requires the use of a weighted summation of the measured impulse-response points. A method of compensating these signals is also given. This compensation allows a small number of sample points to be used while maintaining the mutual independence of the signals.

Two methods of utilizing the control signals to continuously adjust the controllable parameters are formulated. One involves the use of a priori knowledge concerning the expected effects of environmental changes on the performance indices (as might be obtained from a simulation study). The other method involves the use of crosscorrelation techniques to determine the manner of adjustment of the controllable parameters.

The latter portion of the thesis deals with the closed-loop performance of the self-adaptive process when viewed as a tracking loop. A linear model of the process is developed which results in a representation involving three independent adaptive loops, each of which controls only one of the performance indices. On the basis of this model, several compensation techniques are described which aim at optimizing the performance of each adaptive loop. The optimization is based upon minimizing the maximum deviation of the performance indices from their desired values while maintaining the variance (due to the noise introduced in the measurement process) of the indices at a specified level. A numerical example is included for an aircraft autopilot application.

Microfilm \$2.50; Xerox \$6.00. 122 pages.

#### REFLECTION PROPERTIES OF THE SPORADIC-E LAYER OF THE IONOSPHERE

(L. C. Card No. Mic 60-3838)

Howard Myron Swarm, Ph.D.  
Stanford University, 1960

Sweep frequency ionosphere records have been used for the first time to determine the reflection coefficient of multiple type sporadic-E layers. The reflection coefficient was found to change approximately 40 db within the frequency range where the ratio of the fourth-to-first penetration frequencies changes from 0.8 to 1.0. Fifty-five percent of the multiple type sporadic-E records that show four or more reflections have this characteristic.

The amplitude-versus-time records have shown that sporadic-E fading rates are not usually the same for the first and multiple hops. The fading of the first hop normalized to 4.0 mc varies from a very few to as high as 34 maxima per minute, with the second hop rate about twenty-five percent greater.

The lunar tidal variation in height of the sporadic-E layer over Stanford was found to have a 0.6-km peak

amplitude, with the maximum occurring at 6.5 hours after transit. Consistent results are shown for analysis of six months of records in 1951 and two months in 1953. These tidal variations are also consistent with previously reported results at other locations for the normal E-layer. Thus these results are not incompatible with the contention that sporadic-E ionization may be basically the normal E-layer ionization affected by turbulence without the addition of ionization from other causative phenomena.

An ad-hoc model consisting of an array of gaussian distributed electron density columns has been suggested to explain the low and high frequency reduction in reflection coefficient. By changing the number and spacing of the array columns this model may be used to explain the reduction in reflection coefficient of many multiple hop ionograms. Microfilm \$2.50; Xerox \$7.00. 146 pages.

#### RATIONAL APPROXIMATION OF ARBITRARY REAL FUNCTIONS WITH SPECIFIED WEIGHTS

(L. C. Card No. Mic 60-4002)

Tao-Nan Tang, Ph.D.  
University of Illinois, 1960

The problem of obtaining the Tchebysheff approximation of a real continuous function in a closed interval by a polynomial or a rational function under a specified weighting function is treated. Solutions of such problems are obtained by numerical methods involving iterative procedures which may be carried out by modern computing machines.

The effect of shifting a zero or several zeros of an error function on the weighted error function itself is obtained by multiplying the amount of shift by the sensitivity, defined as the partial derivative of the weighted error function with respect to the zero shifted. Various techniques are used to equalize (and hence minimize) the extrema of the weighted error. The knowledge of the zero shifting effect on the weighted error is used to determine the amount of shifts in different cases.

The successive equalization of the weighted error function at the points of extrema gives an iterative procedure with assured convergence of the process. In the case of polynomial approximation, this method yields a set of linear simultaneous equations to be solved in each cycle. In the case of rational function approximation, it results in a set of non-linear simultaneous equations which can be solved by certain special techniques. Special cases such as the approximation with equal-ripple relative error and an approximating polynomial with specified cutoff slope are investigated.

When the function to be approximated is only piecewise continuous with a transition interval specified for each discontinuity, the zero shifting technique can still be used to obtain an error function which is equal rippled in each remaining connected interval in  $[a, b]$ . If a certain integral measure of error is chosen, the solution of approximation is obtained by solving the set of simultaneous equations (non-linear except the polynomial approximation in least squares sense) obtained upon taking partial derivative of the corresponding error measure with respect to all available parameters of the approximating function.



Cases with constraints due to the realizability requirements of different network functions or different network configuration such as symmetry requirements, specified poles, specified cutoff slope, etc. are also investigated.  
Microfilm \$2.50; Xerox \$5.00. 99 pages.

#### SYNTHESIS OF A RESTRICTED CLASS OF DRIVING-POINT FUNCTIONS

(L. C. Card No. Mic 60-4342)

Charles Patrick Womack, Ph.D.  
University of Kansas, 1960

A new method for the synthesis of a restricted class of driving-point functions is presented. Based on an extension of Darlington's procedure for the synthesis of driving-point impedances, it makes use of dissipative RL and RC two-port networks which are terminated in a single capacitance or inductance respectively. This permits the development of synthesis procedures (1) for the realization of non-minimum impedances and in some cases makes use of unbalanced bridge networks so as to involve as few elements as possible (2) for realizing special minimum driving-point impedances without mutuals.

The characteristic process of the method makes use of the following theorem, proof of which is contained in the report.

The driving-point impedance of an RL or RC two-port network which is terminated in a capacitance or inductance respectively can be realized by Brune's process as an equivalent one-port network containing only one capacitance or one inductance (or one perfect transformer) respectively.

The synthesis of a prescribed impedance function commences by first obtaining its expansion using Brune's process. If the resulting network contains either a single inductive or capacitive element, then the new method of synthesis can be applied. Fundamentally this involves obtaining, from the prescribed impedance function, a set of open-circuit, dissipative, two-element-kind impedance functions which satisfy the conditions for realizability as a two-port network. In addition this two-port network, when terminated in an appropriate reactive element (L or C), results in a one-port network which contains fewer elements than the equivalent Brune network.

Some special cases of synthesis of biquadratic and bicubic impedance functions are presented. The specific network realizations are restricted to include only non-series-parallel or unbalanced bridge networks which contain five elements, and no mutual inductive coupling. In general a saving of two resistive elements is possible as compared to the Brune process.

The synthesis techniques developed for biquadratic and bicubic functions are extended to higher order functions. Again use is made of the unbalanced bridge network so that mutual inductive coupling can be avoided. For all those functions to which the present procedure applies, the network realizations will contain fewer elements than the corresponding Brune networks.

Microfilm \$2.50; Xerox \$4.60. 89 pages.

#### ENGINEERING, MECHANICAL

##### DISSOCIATION AND IONIZATION EFFECTS IN THE LAMINAR MIXING OF PARALLEL STREAMS

(L. C. Card No. Mic 60-4764)

Richard Frank Hoglund, Ph.D.  
Northwestern University, 1960

The boundary layer approximation is applied to the equations governing the mixing zone between two parallel semi-infinite streams. The two streams differ in composition and temperature, but they are not necessarily in chemical equilibrium. Closed form solutions are obtained for the approach to equilibrium in the mixing zone in the case of equal velocities of the two streams. Frozen flow and equilibrium flow appear as limiting cases of the general solution. A linearized reaction rate law is used for the non-equilibrium situations. These solutions indicate that the major factor contributing to non-equilibrium effects in the constant velocity mixing zone is the presence of non-equilibrium conditions outside of the mixing zone. An approximate solution to the case of unequal free stream velocities is obtained using an equilibrium condition found to be applicable in the constant velocity case. The results of these studies are used to provide a qualitative indication of the effects of dissociation and ionization reactions on the flow field immediately behind a hypersonic body. It is found that the presence of reactions in various regions of this flow field causes individual and discernible changes in the wake expansion angle and in the base pressure.

Microfilm \$2.50; Xerox \$6.40. 134 pages.

##### DISCRIMINATORY OPTICAL THERMAL PROPERTIES OF SOLIDS WITH RESPECT TO WAVELENGTH AND WAVEFRONT

(L. C. Card No. Mic 60-4178)

Arthur Vincent Houghton, III, Ph.D.  
Purdue University, 1960

Major Professor: Otto W. Witzell

Measurements to determine goniometric and spectral distribution of emissivity of an oxidized metallic surface and spectral distribution of normal emissivity were made. Quartz, calcium fluoride, sodium chloride and potassium bromide filters were used to select the wavelength band received by the detector.

A black body was designed and constructed for calibration of the detection system. Calculations have been made to determine the fraction of black body energy transmitted by different filters and the validity of the method has been experimentally verified.

Measurements of spectral distribution of relative reflectance have also been made.

These measurements have shown oxidized metallic surfaces to exhibit dielectric characteristics at short wave lengths and metallic polarization characteristics at long wavelengths. Coated metallic surfaces are shown to have high reflection at long wavelengths.

These surfaces should be good selective absorbers of

solar energy and further application of these techniques should not only lead to data which can improve the degree of accuracy obtained in radiative heat transfer but should also optimize the desirable characteristics of solar flat plate collectors.

Microfilm \$2.50; Xerox \$5.00. 99 pages.

#### ON THE STABILITY OF HYDRODYNAMIC JOURNAL BEARINGS

(L. C. Card No. Mic 60-4775)

Clarence Joseph Maday, Ph.D.  
Northwestern University, 1960

The objectives of this dissertation are: (1) to investigate the dynamic behavior and stability of the hydrodynamic journal bearing as part of a system which consists of the oil film, the journal-rotor assembly, and the bearing, (2) to show the importance of a stability analysis in bearing design, and (3) to examine the literature concerned with bearing stability.

It is shown that the use of Reynolds' equation, for hydrodynamic lubrication, alone is not sufficient to predict the behavior of the bearing. Using Reynolds' equation alone for the 360° bearing, it is demonstrated that the path of the journal center may have multiple solutions, even under conditions of constant speed and constant load. For quiet running machinery, however, it is desirable that the bearing be designed so that the journal center remains at its equilibrium position. This indicates that additional considerations must be brought to bear so that the behavior of the bearing can be predicted more accurately. An additional consideration meeting this requirement is a stability analysis which uses the oil film forces, obtained from Reynolds' equation, in the equations of motion of the journal-rotor assembly.

Stability analyses are made for: (1) the lightly loaded partial bearing, and for (2) the 360° bearing operating at constant speed and under constant load. These analyses, based on small displacements from the assumed equilibrium position, demonstrate that both of these bearings are unstable for all bearing parameters. In order to study the stability of the partial bearing it was necessary first to derive the equations of the general, dynamically loaded partial bearing of infinite length. These equations also provide a consistent and uniform base for the examination and clarification of the literature concerned with bearing stability.

The analytical work in this dissertation and in other papers, together with the results of experimental investigations of others, show that there are many situations in which bearing instability can be expected. For this reason, each bearing design should include an analysis to insure stability if quiet running machinery is to be obtained.

Microfilm \$2.50; Xerox \$3.00. 55 pages.

#### PREDICTOR CONTROL OF A SECOND- AND THIRD-ORDER NONLINEAR SYSTEM

(L. C. Card No. Mic 60-4196)

John Carl Nicklas, Ph.D.  
Purdue University, 1960

Major Professor: Rufus Oldenburger

The research of this thesis was performed to investigate and extend a particular technique of predictor control design. The technique was first proposed by Oldenburger.\* This predictor control design technique is applied to a second- and third-order nonlinear system.

Each system is composed of two major parts, a controlled plant and a controller. The system output is that of the controlled plant. The relation between the system output variable and the input variable of the plant is described by a nonlinear differential equation. The nonlinearity appears as a signed square term. The controller is divided into a computer or decision making element and a power element that operates at either maximum capacity or zero capacity. The problem of predictor control design is interpreted here to be the determination of the mathematical operations to be performed by the computer to achieve optimum control.

The disturbances investigated in the analysis are step changes in either the desired value of the system output variable or the load on the system. A controller bringing the system to equilibrium in a minimum time after a disturbance dies out is said to achieve optimum control, and an optimum transient is obtained.

In the technique used in this analysis the mathematical operations performed by the computer are said to generate a control function. The value of the control function is dependent upon values of the system output variable, its derivatives, and the physical constants of the system. The sign of the value of the control function is used to determine the polarity of the on-off power element of the controller.

In the analytical derivation of the control functions time is allowed to decrease from the instant at which equilibrium is reached in an optimum transient. Conditions that must be satisfied in order to have an optimum transient are then determinable. The control function is constructed from these conditions.

Six types of optimum transients occur for the second-order system. The transients are classified according to the slope and rate of change of slope of the graphical plot of the system output variable versus time. A control function is found that is valid for all six types of optimum transients. First and second approximations are found for this control function. Control functions are also determined when the positive and negative rates of change of controller output are not equal in absolute value, when the controller has a pure time delay in the switching, and when the controller contains a dead zone.

Eighteen types of optimum transients occur for the third-order system. The control functions are found which determine the operation of the power element in the controller. Sufficient conditions are defined to indicate the required control functions. The analysis specifies the logic required to adequately determine these conditions.



\*Oldenburger, R., "Optimum Nonlinear Control,"  
 Trans. ASME, Vol. 79, 1957, pp. 527-546.  
 Microfilm \$2.75; Xerox \$9.70. 212 pages.

#### EXPERIMENTAL DETERMINATION OF THE VAPOR PRESSURE OF SOLID CARBON

(L. C. Card No. Mic 60-4212)

Rajaram Mangalore Shastri, Ph.D.  
 Purdue University, 1960

Major Professor: Dr. John T. Agnew

The total vapor pressure of solid carbon has been measured by the effusion method. The effusion cell was built from a spectroscopically pure carbon tube of type L113SP made by the National Carbon Company. The cell dimensions were  $\frac{1}{2}$  inch O.D. x  $\frac{3}{8}$  inch I.D. and 4 inches long. The effusion cell was heated inside a specially designed furnace. Resistance heating was employed by passing large currents of the order of 600-700 amps at low voltages.

The carbon vapor effused through a hole of  $\frac{1}{16}$  inch diameter. The vapor condensed inside a capsule suited for this purpose. A vacuum of the order of  $10^{-2}$  to  $6 \times 10^{-2}$  microns was maintained during the test runs. All test runs were made at a temperature of about 2530 degrees K. The vapor was collected for thirty minutes or until the tube failed. The amount of carbon collected was measured by converting it into CO and CO<sub>2</sub> in an atmosphere of oxygen inside a specially designed combustion chamber. The CO was further converted into CO<sub>2</sub> in a CuO column and the total amount of CO<sub>2</sub> was measured by gas chromatography technique. It was observed that the amount of carbon collected increased with successive heating of the same tube. This showed that the rate of effusion increased with the time as the heating was continued. This was attributed to the formation of larger carbon molecules and their increased concentration in the effusing vapor. A quadratic function expressing the rate as a function of time was derived so as to satisfy the experimentally determined points. The rate of effusion at zero time was determined from this equation. The calculation of vapor pressure based on rate of effusion at zero time gave a value of  $1.23 \times 10^{-5}$  atm. for the total vapor pressure of solid carbon at 2530 degrees K.

Microfilm \$2.50; Xerox \$5.00. 97 pages.

#### A DISCUSSION OF SOME STRENGTH CHARACTERISTICS OF ICE AT THE INTERFACE

(L. C. Card No. Mic 60-4218)

John Kennison Stene, Ph.D.  
 Purdue University, 1960

Major Professor: William E. Fontaine

These experiments were undertaken to determine some strength characteristics of the solid-ice interface. It was

desired to find a relation between the stress required to produce a complete and sudden separation at the interface, the temperature and the material. The apparatus, a lever system, was constructed to produce pure tension and pure shear.

Under carefully controlled conditions the tension tests failed to produce complete separation at the interface. The nature of the breaks in the ice and the range of the stress values at the breaking point lead to the conclusion that ice in sample after sample has a heterogeneous arrangement of crystals rather than a geometrically uniform pattern of arrangement.

To obtain a uniform type of interface failure the tension tests were dropped and the shear tests begun. The apparatus was so constructed that the ice and solid would be completely separated at the interface. The scatter in the results of the shear tests again showed the non-uniformity of the collection of crystals of the ice sample. But the results when averaged for each temperature and surface showed definite tendencies which were put into equation form.

The equation was derived from the data by the method of least squares in the form  $S = a T^b$  where S was the average shear stress in psi for all tests at the absolute temperature T, in degrees Rankine. The constants a and b, the latter being negative, are functions of the surface nature and material. The above equation written as  $S = a (460 + t)^b$  was expanded by the binomial theorem and the terms of small value were discarded. The final form was then  $S = c (1 - dt + et^2 - ft^3)$  where S is the average shear stress in pounds per square inch, t is in degrees Fahrenheit, and c, d, e, and f are constants.

Microfilm \$2.50; Xerox \$3.60. 63 pages.

#### ENGINEERING, METALLURGY

##### STRENGTHENING BY PRECIPITATES IN ALUMINUM COPPER ALLOYS

(L. C. Card No. Mic 60-4743)

J. Gerald Byrne, Ph.D.  
 Northwestern University, 1960

This study was undertaken to obtain a better understanding of the manner in which precipitates affect the mechanical properties of age hardenable single crystals of Al base-Cu alloys. Of particular interest is the influence of temperature on the critical resolved shear stress (CRSS) and flow stress of crystals aged to contain various precipitates. The structures studied were Guinier-Preston zones of the first and second kinds (G. P. I and II), the transition precipitate  $\theta'$ , the stable precipitate  $\theta$  and the supersaturated solid solution (reverted). The table on the following page gives the average CRSS values obtained for these states at 4.2°K and 273°K.

The strength due to G.P.I at 273°K arises principally from elastic strains due to misfit between the matrix and zones. The increase in CRSS on cooling to 4.2°K is due partially to chemical hardening attendant to shearing of

State	CRSS at 4.2° K (kg/mm <sup>2</sup> )	CRSS at 273° K (kg/mm <sup>2</sup> )
G.P.I	13.6	7.3
G.P.II	13.6	10.7
$\theta'$	6.0	4.3
$\theta$	1.8	1.2
Reverted	7.9	2.9

the zones and, we suggest, to the intersection of pseudo-dislocations postulated to exist around the zones. Thermal energy assists the shearing at 273°K but is not important at 4.2°K.

Small clusters of Cu atoms are proposed to exist in the reverted state and the elastic strain due to these is thought to account for the CRSS at 273°K. The 169% strength increase observed on cooling to 4.2°K is partially attributed to shearing of the clusters.

For G.P.II zones the strength at 273°K is due to both elastic strains and zone shearing since the zones here are much thicker than G.P.I. The additional strength found at 4.2°K is again suggested to be due to cutting of misfit dislocations postulated to exist around the zones.

When the precipitates are  $\theta'$  and  $\theta$  respectively, the CRSS at 273°K is explained in terms of bending dislocations between the particles. The strength increase of crystals containing  $\theta'$  at low temperatures is again believed due to the intersection of dislocation loops around the  $\theta'$  particles. These have been observed.

Activation volumes and energies derived from change in strain rate experiments extrapolated to 0°K are listed below.

State	Activation Volume	Activation Energy (E. V.)
Reverted	$0.46 \times 10^{-21} \text{ cm}^3$	0.16
G.P.I	0.26 "	0.11
G.P.II	0.45 "	0.09

For the reverted state these values are consistent with the shearing of small Cu clusters. For G.P.I zones the activation energy above is in good agreement with the energy required to put zones back into solution. For G.P.II zones the values are reasonable for the dislocation cutting model proposed earlier.

Crystals containing G.P.II follow the  $\{111\} \langle 110 \rangle$  slip system although slip lines are not generally observed. The deformation in crystals containing principally  $\theta$  or  $\theta'$  is quite different. Many slip systems are operating; these crystals deform like polycrystals. It is suggested that residual loops around  $\theta'$  and  $\theta$  particles from plastic flow are retained three times more effectively at 4.2°K than at 273°K. Easy glide was absent in all states above 77°K and in  $\theta$  and  $\theta'$  below as well.

In summary, existing theory appears adequate for explaining CRSS in the presence of precipitates at room temperature, but the large increase in CRSS observed on cooling requires an additional mechanism. Misfit dislocations around G.P.I, G.P.II, and  $\theta'$  are proposed and the

additional CRSS at 4.2°K is attributed to the necessity for providing extra stress to cut these.

Microfilm \$2.50; Xerox \$6.60. 137 pages.

#### A NEW X-RAY DIFFRACTION METHOD FOR DETERMINING THE CRYSTAL SIZE DISTRIBUTION OF A POWDER

(L. C. Card No. Mic 60-4174)

Barrett Henry Heise, Ph.D.  
Purdue University, 1960

Major Professor: Dr. Pekka Rautala

The determination of fine crystal size is an old problem in x-ray diffraction theory; however, previous work by the author showed that no reliable solution to the problem had yet been found.

The former theory is based on the idea that the crystal size information can be evaluated from the Fourier inversion of the intensity function by analyzing a sum of self convolutions of shape functions. Under the assumptions of the theory, this analysis is made by means of two differentiations. The sum of the self convolutions arises from the assumption that the intensity is proportional to the sum of the squares of the shape function transforms.

In the present work, the intensity is shown to be proportional to the square of the average value of the shape function transforms which is, by definition, the square of the sum of the transforms divided by the number of such transforms in the sample. Hence the square root of the intensity function is taken to represent the sum of the transforms. The size distribution is the first derivative of the Fourier inversion of the sum of the shape function transforms thus found.

The size distribution of the silver crystals in an exposed and processed photographic emulsion had been determined by use of the former method. These results showed considerable scatter of the data points of the distribution. They further indicated negative probabilities that crystals of certain sizes exist in the specimen. The new method was tested on the same photographic emulsion and also on a fine corundum polishing powder. Smooth, positive size distributions were obtained.

Microfilm \$2.50; Xerox \$5.40. 110 pages.



**DEFORMATION OF LITHIUM-MAGNESIUM  
ALLOY SINGLE CRYSTALS**

(L. C. Card No. Mic 60-3702)

Shiu Kang Tung, Ph.D.  
University of Pennsylvania, 1960

Supervisor: R. Maddin

The lithium-magnesium alloy single crystals were prepared by the conventional Bridgman method in a continuous stream of purified argon and extended plastically in an Instron machine. Three different compositions were used, i.e., 30, 45.6 and 52.4 atomic percent lithium. The specimen axis, before and after deformation, was determined using the usual Laue back reflection method. After plastic deformation, the observed slip traces, which were approximately straight in most cases, were used to determine the slip plane by the two surface stereographic method. The specimen axis, in all cases, rotated towards the [111] pole. Hence the slip direction in these crystals may be represented by [111].

In general only one set of slip traces was observed in the early stage of deformation. After several successive extensions, the slip traces become rather complex. The slip planes as determined from these traces were generally planes of high indices. The angles between the slip plane and slip direction were determined with the aid of a stereographic projection. A maximum shear stress condition was observed.

From the observed data, the critical shear stress was calculated and plotted against temperature at constant composition. It decreases linearly as the temperature increases from 93°K to 293°K. From 293°K to 473°K the

decrease in strength tends to diminish and the curve tends to become horizontal.

The temperature dependence over a range of lower temperatures and the temperature independence over the range of higher temperatures were discussed in detail using the model of a dislocation forest. It is assumed that the yield strength in tension is the applied stress required to move a sufficiently large number of dislocations per unit time over a sufficiently large area in the glide plane. The moving dislocations should encounter two types of opposing stress fields, one from dislocations which lie on the slip plane and are roughly parallel to the moving one and have the same Burger's vector. The other contribution to the flow stress comes from the dislocations that penetrate the glide plane more or less perpendicularly. However, this argument is considered to be part of the contribution to the yield stress in case of body centered cubic metals. The Peierls-Nabarro force must be given greater consideration in the mechanical properties of non-densely packed metals. Therefore, it is suggested, in addition to this forest model, the Peierls-Nabarro force must come into play.

The composition dependence of critical shear stress was explained by employing the dislocation model suggested by Mott and Nabarro. The observation of the linear relationship between critical shear stress and composition may only be an approximation. The change of lattice parameter with composition should be taken into consideration.

Finally, the observed jerky plastic flow at room temperature and 223°K was discussed. The serrated effect during tensile deformation is attributed to short-range ordering effect.

Microfilm \$2.50; Xerox \$6.60. 139 pages.

## FINE ARTS

### WASHINGTON ALLSTON AS CRITIC

(L. C. Card No. Mic 60-3436)

Mabel Raynor Bartlett, Ph.D.  
Boston University Graduate School, 1960

Major Professor: William M. Jewell

A scholarly treatise on art, written by an American artist in the first half of the nineteenth century, and almost completely ignored in the history of American art and thought, provided the original incentive for the study of Washington Allston as critic. An additional incentive derived from the paradox of a reputation which was phenomenal in the artist's lifetime but which had deteriorated almost to a nullity by the end of the century in which he lived.

An examination of the reputation and actual influence of Allston as critic, and an effort to trace the development of his thought involved a scrutiny of biographical material available in legal documents, manuscript notes, correspondence, memorabilia, biographies, and biographical sketches; references to the artist in newspapers, magazines and literary works; an examination of American criticism; and the history of criticism and of American thought, with particular reference to the development in New England.

Since Allston lived just at the turn of the century, read not only English, but Latin, Greek, French, and Italian, and resided for fifteen years in European capitals, any attempt to relate his theory to all its possible antecedents appeared to be pointless, thus only the major English critics of the eighteenth century with other theorists known to have been influential were consulted in relation to the development of Allston's ideas. The profound and personally acknowledged influence upon his thought by Samuel Taylor Coleridge was investigated by an examination of the major works of this writer and biographical research on his relationship to Allston.

The analysis and evaluation of Allston's critical theory required the study not only of his posthumously published treatise, *Lectures on Art and Poems*, but also his unpublished verse, his novel *Monaldi*, his correspondence, recorded conversations, memoranda and uncompleted manuscripts. To establish the significance of Allston's criticism, the nature and extent of his contribution was investigated by reference to his correspondence and writings, the comments of his contemporaries, and recent studies on nineteenth century American criticism.

Evidence deduced as the result of this research indicates that because of the quality and scope of Allston's contribution as critic and the extent of his influence, he should be considered a major influence in the movement known as the New England Renaissance and that the originality and philosophical quality of his scholarly thought entitle him to a unique position as a critic of art, not only in nineteenth century America, but in the world field. The evidence indicates that he should stand beside his friend, the literary

critic Coleridge, in the very forefront of nineteenth-century criticism, and that he is related by his critical theory to aspects of contemporary thought.

Microfilm \$3.15; Xerox \$11.05. 244 pages.

### A HISTORY OF THE WHITNEY MUSEUM OF AMERICAN ART, 1930-1954

(L. C. Card No. Mic 60-3748)

Daty Healy, Ph.D.  
New York University, 1960

Chairman: Professor Alonzo F. Myers

#### The Problem

The purpose of this study was to trace the history of the Whitney Museum of American Art, to identify its role among the museums of the New York Metropolitan area, and to identify the factors which contributed to the development of the institution. Since the Whitney Museum, founded by Gertrude Vanderbilt Whitney, grew out of other organizations established by Mrs. Whitney, its history includes that of its precursors: the Whitney Studio (1914), Friends of the Young Artists (1915), the Whitney Studio Club (1918), and the Whitney Studio Galleries (1928). The study did not purport to evaluate the activities and the contributions of the Whitney Museum, but rather sought to trace its historical development and to define the factors which determined that development.

#### Procedure

Wherever possible, a chronological approach was employed. The fact that some of the precursors of the museum were engaged simultaneously in similar activities made strict chronology impossible. Material related to the Whitney Museum was divided into time spans: 1930 - 1948 and 1948 - 1954. These divisions mark a change of administration (1948), and a change of location (1954).

Chapters II and III are concerned with general background and activities of the organizations preceding the museum. Subsequent chapters, treating of the activities of the museum, were dealt with under such headings as: exhibitions, collection, loans, research, publications, and activities in the interest of American art.

Studies of the collection as it existed in 1931, 1937, and 1954 were made in order to identify changes in its development.

Summaries of the exhibition programs for the various Whitney organizations were included and studies of particular annual exhibitions, spaced at intervals, were made in order to reveal trends and to distinguish the achievement of exhibitors.

From these studies and from data relating to the role played by the museum in the New York Metropolitan area and in the national scene, conclusions were drawn as to



the factors which contributed to the development of this institution.

#### Conclusions

It was found that from 1914, when the Whitney Studio was established, until 1954, when the Whitney Museum moved from its original Eight Street location, the museum and its predecessors played an active role in the New York Metropolitan area and a role which was singular in that it was dedicated to the development of American art and American artists.

The museum and its forerunners, through regular exhibition programs and through a policy of purchases rather than awards, consistently gave support to the American artist. Through exhibitions, loans, and publications, the museum consistently shared its interests with the general public. Through cooperation with other museums, art

organizations, and the United States government, it initiated and supported many activities whose purposes were to further the development of American art and to promote the welfare of American artists.

It was found that the generosity and friendliness of the museum's founder, Gertrude Vanderbilt Whitney, and the warmth and imagination of its first director, Juliana Force, created for the institution an atmosphere of gracious hospitality which persisted throughout the period of this study.

It has been concluded that through persistent adherence to purposes; through continued programs of exhibition, collection, loans, research, and publication; through constant support of activities in behalf of American art; and through a warm and hospitable atmosphere, the Whitney Museum distinguished itself as a noteworthy institution among the museums of the New York Metropolitan area.

Microfilm \$4.55; Xerox \$16.00. 355 pages.

## GEOLOGY

### GRAVITY AND MAGNETIC MEASUREMENTS IN EASTERN KANSAS

(L. C. Card No. Mic 60-4317)

Mahlon Marsh Ball, Ph.D.  
University of Kansas, 1960

During 1958 and 1959, 650 gravity and 200 magnetic observations were made in a study of gravity anomalies in eastern Kansas. The measurements show that intrabasin lithologic differences are the causes of these gravity anomalies. Anomalies occur where relatively denser basic igneous rocks and relatively lighter granites and metamorphics are adjacent in the basement complex. There is good agreement between regional gravity and regional structural trends, and it is concluded that this is because both structural and gravity anomalies are related to intrabasin lithologic differences.

The Midcontinent Gravity High which extends from the Lake Superior region south into Kansas was the principal anomaly studied. The positive portion of this anomaly results from the presence of a block of basic igneous rock approximately 30 miles wide and five miles thick with its upper surface at or near the basement surface. The negative anomalies which border the gravity positive are genetically related to it. They are caused by the downsagging of relatively less dense granites to replace extruded basic material and by the trapping of low-density sediments in the topographic lows formed at the surface above the down-sagged granite blocks. The support by the crust since Precambrian time of the load represented by the positive portion of this anomaly is indicative of great tectonic stability and crustal strength in the midcontinent area.

Small local positive gravity highs on the crest of the Nemaha Anticline are exceptions to the general rule that basement surface relief is not responsible for gravity anomalies in Kansas. The explanation of these anomalies is that relief on the Nemaha Anticline is sufficient in places to put Precambrian granites adjacent to relatively low-

density Pennsylvanian and Permian rocks. There are no anomalies where the granites are only in juxtaposition with Lower Paleozoic rocks because the resulting density contrast is insufficient to cause them.

Local investigation at Big Springs and Valencia showed the presence of basic igneous stocklike intrusions in the basement complex beneath these towns. These anomalies reflect local protrusions on a deeper basic igneous rock mass which underlies much of Johnson, Miami, Douglas, and Shawnee Counties.

Northeasternmost Kansas is the locus of a regional gravity high. The steepest Bouguer anomaly gradients bounding this high are in Atchison County. This indicates that the contact of the basic material which causes this gravity high with low-density granitic rocks is steepest and at shallowest depth in the Atchison area. Observations at Baileyville in Nemaha County indicate the presence of basic igneous rock on the west flank of the Nemaha granite ridge. Measurements on the granite outcrop in Woodson County known as Rose Dome indicate this body is sill-like in form.

Microfilm \$2.50; Xerox \$7.20. 151 pages.

### GEOLOGY OF THE BIG BASIN AREA, SANTA CRUZ MOUNTAINS, CALIFORNIA.

(L. C. Card No. Mic 60-3792)

Earl Edward Brabb, Ph.D.  
Stanford University, 1960

The Big Basin area is in an oil producing district, and includes 65 square miles of heavily forested and mountainous terrain in Santa Cruz and San Mateo counties, California. The region is near the western border of the Coast Ranges, and is classical inasmuch as some of the strata were the first in California to be assigned to the Oligocene Series.

The oldest sedimentary rocks are Paleocene in age, and rest non-conformably on quartz diorite. They are mapped, described, and named the Locatelli formation. This is a new target for oil exploration as the formation has not been reached at depth in previous tests.

The Butano sandstone of late Eocene (Narizian) age is divided into six informal units, which may prove to be members. The extensive outcrops of the Butano near Pine Mountain were correlated with the type area, thus establishing that the formation is about 9,000 feet thick. The upper part of the unit in its type locality is described in detail, its faunas listed, and representative samples tested for porosity, permeability, and grain size distribution.

The San Lorenzo formation of Eocene and Oligocene age is divided and mapped as two members, named herein the Twobar shale and Rices mudstone. The latter unit is the type Oligocene of California, although it probably does not correspond to the Oligocene Series of Europe. The type section of these members, along Kings Creek, is described, and the fossils recorded. The formation is further subdivided into five informal units, which may have regional significance. Glauconites at the contacts of some of the units mark the base of stages, and are useful in facies analyses. They also indicate disconformities within the formation. Fossils in the San Lorenzo are listed, and indicate that the Twobar shale is Narizian and that the Rices mudstone is Refugian and Zemorrian.

The Vaqueros sandstone of Oligocene (Zemorrian) age is divided into two informal units, and its lithology and faunas along Kings and Bear creeks described in stratigraphic columns. Its texture, composition, and physical properties are similar to those of the Butano sandstone.

The Monterey group consists of early Miocene (Luisian) and Mio-Pliocene (Delmontian?) formations. Sands near the base of these siliceous mudstone units are described in three stratigraphic columns, and their texture, composition, and physical properties listed. They contain considerably more plagioclase feldspar than the Butano and Vaqueros sands.

Large scale mapping and subdividing the formations have resulted in several structural refinements. The Ben Lomond and Zayante faults were extended westward. The Butano anticline is more complicated than formerly believed. Nine structural sections across the area reveal five additional folds, named herein the Big Basin, San Lorenzo, and Riverside synclines, and the Johansen and Camp Campbell anticlines; and two additional high angle dislocations, named the Opal Creek and Sawmill faults. Attention is called to the sharpness of some folds in an area traditionally thought of as characterized by rigidity and strength.

Several inferences were drawn about the provinces, paleogeography, and depositional environments in early Tertiary time. The sediments were probably deposited at bathyal depths; they were derived chiefly from the Monterey pluton, which was part of Reed's Salinia southwest of Big Basin.

Land, water, and probably petroleum are the important resources of the Big Basin area. Several structures could contain oil, but the most favorable place for a test is on the Johansen anticline.

Microfilm \$3.40; Xerox \$11.95. 262 pages.

# PALEOZOIC SEQUENCES IN THRUST SLICES OF THE SEETOYA MOUNTAINS, NORTHERN INDEPENDENCE RANGE, ELKO COUNTY, NEVADA.

(L. C. Card No. Mic 60-3092)

James William Kerr, Ph.D.  
Columbia University, 1960

Three structural sequences of lower Paleozoic rocks in the Seetoya Mountains east of Tuscarora, Nevada, are of partly equivalent age. The highest sequence is Middle to Upper Ordovician bedded cherts, quartzite, volcanics, and graptolitic shales, deposited in a western eugeosynclinal belt. This has been thrust southward or southeastward for some scores of miles. Each of two lower sequences includes the same five Ordovician and Silurian formations which differ in thickness and in lithic details. They are predominantly carbonate rocks with some quartz sandstones, deposited in an eastern miogeosynclinal belt. The upper of these latter sequences has been thrust southward or southeastward six or more miles.

The eastern sequences were folded, faulted, and eroded in pre-Carboniferous or Permian. Siltstones laid unconformably on the southern of the two eastern sequences may have been derived from rising lands in the eugeosynclinal belt. Nevadan or Laramian thrusting carried a thick plate of allochthonous rock of the western belt southerly or southeasterly. The presence of younger rocks beneath the thrust in the south suggest that there was a regional southward slope at this time. A second thrust which developed within the eastern belt carried parautochthonous rocks, and may be a subsidiary thrust initiated by movement of the overriding rocks of the western belt; this thrust shows a close similarity to the peel thrusts of the Western Alps. Block faulting during the Tertiary is largely responsible for the present-day north-south trend of the range.

Microfilm \$2.50; Xerox \$6.40. 133 pages.

# SURFICIAL GEOLOGY OF THE ELBOW-OUTLOOK AREA, SASKATCHEWAN, CANADA.

(L. C. Card No. Mic 60-3993)

John Stanley Scott, Ph.D.  
University of Illinois, 1960

Surficial deposits of the Elbow - Outlook area, which comprises 1130 square miles in south central Saskatchewan, consist of Pleistocene till; proglacial lake deposits of sand, silt and clay; deltaic sand and gravel deposited at the junction of glacial meltwater channels and proglacial lakes; Post-Pleistocene alluvial deposits of the South Saskatchewan River and aeolian deposits. A late Wisconsin age, inferred from regional stratigraphic relationships, is assigned to the Pleistocene deposits.

Hummocky moraine and undulating ground moraine are the characteristic surface forms of the till areas in contrast to the flat to gently undulating areas of lake deposits. Parabolic dunes are the dominant form of the sand accumulations and the deflation pits are elongated to the northwest in the direction of the prevailing wind.



The Upper Cretaceous Belly River and Bearpaw formations underlie the area and are shown to be higher in altitude under the moraine covered topographic highs of the Coteau and Strongfield Upland than in the intervening South Saskatchewan River Lowland.

The regional consequent slope of the area, toward the northeast, and the Pre-Pleistocene bedrock topography were the principal factors which affected the accumulation of Pleistocene deposits during the advance and retreat of the glaciers.

Ice flow markings indicate a local glacial advance from the northeast. During deglaciation the upland areas were first uncovered, after which the ice retreated from the South Saskatchewan River Lowland. Positions of the ice front during the stages of retreat toward the northeast are marked by abandoned meltwater channels rather than by end moraines. A minor, local readvance of the ice is marked by stratified sand and gravel contained between deposits of till.

As shoreline features of the proglacial lakes are almost entirely absent lake elevations and therefore lake extents are determined from altitudes of delta deposits, lake drainage outlets and the distribution of lacustrine sediments.

Clay mineral studies show no significant variation between the clay mineral composition of lacustrine and till deposits; it is concluded that the lacustrine material was locally derived from till. The high percentage (50 to 70 percent) of montmorillonite in the less than two micron fraction of the till is a reflection of the Bearpaw formation as a source for the till matrix.

Ground water occurs in isolated lenses and pockets of sand and gravel at varying depths within the Pleistocene deposits and from sandy layers within the Bearpaw and Belly River formations. Some of the bedrock aquifers are under artesian pressure. The artesian pressures are probably developed from intake areas 100 miles or more west of the Elbow - Outlook area although petroleum gas pressures may have produced local artesian conditions. Recharge to aquifers is probably a small percentage of the annual precipitation, although significant recharge to aquifers in Pleistocene deposits may occur from influent seepage from the South Saskatchewan River and by upward leakage from the artesian bedrock aquifers. An estimate of the rate of penetration of water through till, based on water flooding data, is 1 foot per day.

The Quaternary deposits at the South Saskatchewan River Project damsite present no serious engineering problems in the construction of a rolled-earth fill dam. The swelling characteristics of Bearpaw shale, which underlies the damsite, create a significant problem in the construction of the dam and its appurtenant structures. The rehydration energy of the montmorillonite within the Bearpaw shale is proposed to explain the swelling pressures, increases in volume and moisture content which have been attributed to "time rebound."

Microfilm \$2.50; Xerox \$6.40. 133 pages.

# THE GEOLOGY OF THE MOXIE PLUTON, WEST-CENTRAL MAINE.

(L. C. Card No. Mic 60-4806)

Glenn S. Visher, Ph.D.  
Northwestern University, 1960

The Moxie Pluton is a mafic intrusion, approximately 40 miles long and from one-half to five miles wide, in west-central Maine. It is associated with a belt of mafic and ultramafic intrusions that can be traced from Newfoundland to Massachusetts. The Moxie Pluton intrudes folded Silurian (?) rocks, but is itself undeformed, and is therefore interpreted to be of post-Acadian age.

The pluton was intruded into isoclinally folded slates. The cleavage and bedding of these rocks were warped from their regional N 30°-40° E trend, and near the intrusion are parallel to the contacts. Near the pluton the slates were recrystallized to schist, gneiss, and hornfels. New minerals in the metamorphic aureole include chialstolite, cordierite, plagioclase, potash feldspar, sillimanite, spinel, garnet, and orthopyroxene. The width of the aureole ranges from one-quarter of a mile to three miles, and there is a range in metamorphism from granulite facies at the contact of the intrusion to green-schist facies in the country rock unaffected by the intrusion. Local pegmatitic segregations, composed of quartz, feldspar, and tourmaline, occur in the gneissic rocks, and are interpreted as resulting from anatexis.

The rocks of the Moxie Pluton are dunite, troctolite, olivine norite, anorthosite, and ferriferous olivine norite, all formed as a result of fractional crystallization of a parent noritic magma. The range of composition in the major minerals is: orthopyroxene  $Of_{9-66}$ ; olivine  $Fa_{10-83}$ ; and plagioclase  $An_{55-90}$  ( $An_7$  in a micropegmatite).

Evidence was found in only one thin section that orthopyroxene had inverted from pigeonite, although in many mafic bodies such evidence is typical of orthopyroxenes less magnesian than about  $Of_{30}$ . Olivine is a major constituent of the iron-rich rocks, and is typically associated with orthopyroxene, titaniferous-magnetite, sphene, and apatite. The last three occur in rocks with high Fe/Mg ratios.

Tourmaline-bearing micropegmatite is associated with the pluton and occurs as veins and masses cutting norite and ferriferous norite. The micropegmatite is interpreted as the last stage of crystallization of the Moxie Pluton.

A study of spectrographic analyses of 21 rocks of the pluton by means of scatter diagrams, ratios, and variation diagrams indicates that  $V_2O_5$ ,  $TiO_2$ , and MnO are related to the distribution of FeO, and that  $Cr_2O_3$  and NiO are related to the distribution of MgO. Relative concentrations of FeO and related oxides increase in a linear manner during differentiation, and MgO and related oxides decrease exponentially with differentiation. NiO probably replaces FeO in the olivine lattice, and  $Cr_2O_3$  replaces FeO in the pyroxene lattice, MnO substitutes for FeO,  $V_2O_5$  is probably present in magnetite, and  $TiO_2$  is largely in ilmenite and sphene.

The pluton consists of two funnel-shaped bulbs connected by a long, narrow, tabular body. Internally there are three types of structures: a layering due to variation in modal frequency of the minerals often coupled with textural variations, a cryptic layering resulting from changes

of composition within mineral series, and an igneous lamination or preferred orientation of the constituent minerals. A statistical study of the mineral orientation indicates that flow was a contributory factor in the formation of the

pluton. The layering and associated cryptic layering were produced by crystal fractionation modified by both gravitational and convective forces.

Microfilm \$2.50; Xerox \$6.80. 143 pages.

## HEALTH SCIENCES

## HEALTH SCIENCES, GENERAL

ANALYSIS OF GOALS AND ACTIVITIES  
OF THE CARDIAC WORK EVALUATION CLINIC  
OF THE UNIVERSITY OF PITTSBURGH  
AND THE WESTERN PENNSYLVANIA  
HEART ASSOCIATION — A STUDY OF  
ADMINISTRATIVE METHODOLOGY FOR  
ASSESSING THE EFFICIENCY OF  
RESEARCH PROJECTS

(L. C. Card No. Mic 60-4419)

Roswell George Daniels, M.D., Ph.D.  
University of Pittsburgh, 1960

Administrators are continually faced with the problem of evaluating the quality and productivity of medical research projects. A formal method for such an evaluation was prepared. The abstractions and generalities in this method were developed around and applied to an ongoing project in the vocational rehabilitation of cardiac individuals.

In formulating this method of evaluation, the investigator analyzed research as to its types, component parts, methodology, and results. Any assessment of the quality of an activity so variable in its methodology as research justifiably can be resolved only in terms of whether the project should produce good research -- a valid, unequivocal answer to the objective. Certain fundamental principles and ingredients involving study objectives, definitions, facilities, budget, study groups, measurements, record forms, method of analysis, personnel, public relations, pilot studies, and interpretation of results, increase the probability of good research. These principles provide the basis of the investigator's method of assessment. The principles and ingredients were selected from an extensive analysis of the technical literature concerning research, statistical books, administrative literature, and several medical research projects; from statistical, epidemiological and general lectures concerning research; and by discussions with prominent local, regional, and federal investigators.

In assessing the cardiac work evaluation clinic (CWECC) project, background information in the field of cardiac rehabilitation was obtained by abstracting pertinent literature and preparing an extensive bibliography, by actively participating in that particular clinic, through attending appropriate professional meetings, and visiting other similar facilities in this geographic region. The current CWECC project was comprehensively analyzed for the selected ingredients which promote good research. The type and quality of presently accumulated data were assessed,

and the research questions answerable with these data analyzed. To understand all aspects of the project, the investigator assisted in preparing the clinic's current research results. Major weaknesses in the CWECC project are found in the following areas: (a) objective observations, (b) lucid definitions, (c) well defined objectives, (d) valid measurements systematically collected, (e) statistical design formulated at the time the project was initiated.

Since an unequivocal answer could not be obtained for the CWECC major research objective, changes in their current objectives were considered. Criteria were prepared for possibly using the current clinic data for resolving pertinent newly-suggested objectives, but it appeared that no new important objective could be achieved. Similarly new objectives requiring the assembled data, but permitting modifications of the study methodology, were sought in vain. In attempting to formulate new objectives the investigator prepared a list of all his pertinent research questions in cardiac rehabilitation -- approximately 250 questions of varying relevance. Each of these was assessed for possible resolution with the current clinic data. Since no new major objective could be satisfactorily answered by the clinic's current data, new objectives were suggested compatible with the service aspects of the clinic. These objectives would ascertain the type and duration of rehabilitation of favorably motivated cardiac patients and factors related to this rehabilitation. Their achievement would require the establishment of a new program utilizing groups of patients currently attending the clinic and new admissions. New methodology for collecting, evaluating, and interpreting the new data were recommended for pursuing the new objectives. Additional avenues of research in the physiological, psychological, and administrative aspects of cardiac rehabilitation and factory studies were suggested as desirable for interested research groups.

Microfilm \$3.40; Xerox \$11.95. 262 pages.



AN INSTRUMENT FOR EVALUATING  
COLLEGE AND UNIVERSITY  
HEALTH SERVICE PROGRAMS

(L. C. Card No. Mic 60-4887)

Robert Henry Kirk, H.S.D.  
Indiana University, 1960

Chairman: Donald J. Ludwig, H.S.D.

**The Problem.** The problem was concerned with the construction of a valid, reliable, and objective instrument for evaluating college and university health service programs.

**Procedures.** A preliminary instrument was constructed after complete analysis and refinement of 764 health service standards found in the literature. The preliminary instrument contained 291 health service standards which were appropriately distributed among eight areas. The content of the preliminary instrument was rated by a national jury of 40 members of the American College Health Association. All jurors were health service personnel. The Peters and VanVoorhis Formula was used in correlating the 40 jurors' ratings. Analysis of the results of this procedure served as the basis for revision of the preliminary instrument.

The revised instrument contained 247 health service standards. The content of the revised instrument was weighted by a national jury of 48 members of the American College Health Association. All jurors weighting the instrument were health service personnel. As a result of jurors' weightings, point values were assigned to the content of the revised instrument. The Peters and VanVoorhis Formula was used to correlate the 48 jurors' weightings of the content of the revised instrument. The execution of all procedures to this point resulted in a curricularly valid instrument for evaluating college and university health service programs.

The instrument was administered to 12 Indiana colleges and universities, both as a self-appraisal device and as a survey appraisal device. Health service directors appraised their own programs. These programs were also appraised by the investigator in all instances and by other outside raters in six instances.

Reliability of the instrument was determined by the "split-instrument" method of correlation. This was determined for the instrument both as a self-appraisal device and as a survey appraisal device.

Objectivity of the instrument was estimated by correlating the scores obtained by the three different combinations of raters. The raters were 1) investigator and health service director; 2) investigator and another outside rater; and 3) the other outside rater and the health service director. The Pearson Product-Moment Formula was used to treat the data.

**Conclusions.** The most important conclusions are as follows:

1. The instrument is curricularly valid for the purpose of evaluating college and university health service programs.

2. In terms of internal consistency, the instrument is reliable both as a self-appraisal device and as a survey appraisal device.

3. The instrument is highly objective in evaluating college and university health service programs when administered by persons oriented to its use.

4. The instrument can easily be administered both as a self-appraisal device and as a survey appraisal device.

**Recommendations.** The most important recommendations are as follows:

1. As a survey appraisal device, the instrument should be administered only by interview, preferably with the health service director.

2. As a self-appraisal device, the instrument should be administered with the self-rater possessing the most objective attitude possible.

3. The instrument should be administered nationally to colleges and universities for the purpose of obtaining more adequate indications of its reliability and objectivity.

4. Standards within the instrument should be reviewed, revised, rerated, and reweighted at least every five years by a jury of health service personnel representing all possible types and sizes of colleges and universities.

5. The instrument should be made available to the American College Health Association for adoption.

6. The instrument should be used for program status research in the area of college and university health service.

7. A study might be made to determine the effectiveness of student health service programs in relation to the general health of the student body.

Microfilm \$3.15; Xerox \$11.05. 244 pages.

HEALTH SCIENCES, INDUSTRIAL

A METHOD FOR ASSESSING MINIMAL  
PULMONARY EDEMA PRODUCED BY  
GASEOUS DEEP-LUNG IRRITANTS

(L. C. Card No. Mic 60-4418)

James Earl Long, Sc.D.Hyg.  
University of Pittsburgh, 1960

The objective of this thesis was to develop and evaluate a method for measuring, in physiological terms, the magnitude of response, in small animals, from low-level exposures to deep lung irritants. The method made use of the respiratory uptake of carbon monoxide as an index of pulmonary impairment.

The apparatus consisted of an animal chamber, an air circulating pump, an adsorbing chamber for water vapor and carbon dioxide, and a thermal equilibrating coil connected in series in a closed-circuit and immersed in a water bath. A conducting tube led through a flowmeter into an ionization chamber connected in series with a vibrating-reed electrometer capable of detecting the ionization products of carbon monoxide -C<sup>14</sup>. The air from the ionization chamber returned to the main circuit to join the re-circulating air stream. An electronic circuit amplified the current produced in the ionization chamber, in proportion to the carbon monoxide concentration, and this was recorded continuously.

An unanesthetized animal in the chamber absorbed carbon monoxide (added, at the outset of a test) as well as oxygen from the circulating air, as a result of which the carbon monoxide concentration decreased progressively

with time. Since the animal breathed, at a reasonably steady rate, a carbon monoxide concentration (120 ppm.) which had no physiological effect nor did it increase significantly the percentage of blood saturation with carbon monoxide, the rate of carbon monoxide uptake by the animal per unit air concentration was constant and, therefore, there was a constant percentage decrease in the concentration of carbon monoxide in the re-circulating air from which the absorption rate by the animal could be estimated.

Based on considerations from partitioned respirometry, the dual dependence of carbon monoxide on ventilation and diffusion for its cardiorespiratory absorption was discussed and it was shown that the rate of uptake of this gas can be used as an index to measure, jointly, changes in diffusion capacity and in ventilatory performance as these may be affected by the presence of edema fluid in the lungs.

Preliminary studies indicated that the rate of respiratory uptake of carbon monoxide by rats was quite uniform among a group of normal animals of approximately equal weights and that the test-to-test reproducibility on the same rat was high. This established the validity of using this index of normal respiratory function as a base-line against which to compare levels of functional performance in rats after imposition of a deep lung insult. These preliminary studies also indicated that the procedure could be used to test small animals at hourly intervals with very little, if any, disturbance to them, as indicated by the relative uniformity of the observed breathing frequencies in all the test rats.

A demonstrated correlation between loss of carbon monoxide absorbing capacity and increase in the lung-to-body weight ratio (accumulation of edema fluid) indicated that the reduction in carbon monoxide uptake can be regarded as a direct index of the magnitude of pulmonary edema.

The method made it possible to follow the time-course of development and recovery from pulmonary edema.

A series of 30-minute exposures to phosgene were conducted with rats at concentrations ranging downward from 5 to 0.5 parts per million. As an explanation for the characteristic delay in outward signs of respiratory distress following exposure to deep lung irritants, it was shown that the edema reaches its maximum level in six to eight hours. This is followed by a relatively long recovery period of 48 hours or more.

The sensitivity of the method was indicated by the finding of measurable loss in carbon monoxide absorbing capacity from exposures of one part per million and less for only 30 minutes.

The method offers possibilities for the investigation of effects from long-term exposures to sub-lethal levels of pulmonary irritants, particularly, to reveal irreversible and cumulative damage or acquired tolerance and to obtain information that may aid in establishing human tolerance levels for exposure to polluted industrial and community atmospheres. Microfilm \$2.50; Xerox \$5.60. 114 pages.

## HEALTH SCIENCES, PATHOLOGY

### THE USE OF VIABLE WHOLE EMBRYO CELLS TO PRODUCE SURVIVAL IN LETHALLY X-IRRADIATED MICE: A QUANTITATIVE STUDY OF THE FACTORS INVOLVED.

(L. C. Card No. Mic 60-4817)

Norman S. Wolf, Ph.D.  
Northwestern University, 1960

Adult mice of an inbred strain were given 790 r of whole body X-irradiation as measured in air. The mice actually received 1185 r, as measured in a phantom, by a method utilizing maximum backscatter of radiation. Irradiation was followed by intravenous injection of isologous or homologous whole embryo cells. The doses of viable cells injected were  $2 \times 10^6$ ,  $7 \times 10^6$  and  $25 \times 10^6$ , and were determined by a method involving the use of two different cell-staining procedures. Basing the cell dose on numbers of viable cells only was found to be a valuable procedure in stabilizing experimental conditions. Embryos of mixed ages were used for the isologous cell injections. Those used for the homologous cell injections were divided into 3 post-conceptual age groups: 11 - 12 days, 14 - 15 days and 18 - 19 days.

Thirty-day survivals of mice in the groups treated with isologous embryo cells were directly related to the dose of cells given, resulting in a nearly linear relationship. The survivals were about 30, 50 and 75% for the respective dosages. When considered at the  $2 \times 10^6$  and  $7 \times 10^6$  cell dosages, the survivals among mice receiving 14 - 15 or 18 - 19 day homologous embryo cells were similar to those for mice receiving isologous cells, although the 14 - 15 day group was somewhat lower. However, in these same two homologous embryo-treated groups the  $25 \times 10^6$  cell dose resulted in no increase in survival over  $7 \times 10^6$  cells. The 30-day survival in mice injected with 11 - 12 day embryo at the  $2 \times 10^6$  and  $7 \times 10^6$  viable cell doses was nearly zero (the  $25 \times 10^6$  cell dose was not feasible in this embryo age group).

It was found that nearly all of the 30-day mortality in all of the groups of mice occurred within the first half of that time period. There was no evidence by way of 30 - 90 day survivals that homologous disease was occurring among the mice as a result of treatment with homologous embryo cells. A number of deaths did occur during this time period, more often among the isologous animals than among the homologous ones. Mice injected with the 14 - 15 day homologous embryo had the lowest mortality for this period.

Age, between 3 and 13 months, and weight of the mice receiving X-irradiation followed by whole embryo cell injections were not found to be important variables in determining 30-day survival. However, male mice were found to have a significantly higher survival rate than females.

The occurrence of cataracts was found to agree with what might be expected in mice surviving high doses of X-irradiation.

A limited study of the gross and microscopic condition of tissues from mice given the various types and dosages of embryo cells after irradiation was carried out at several post-treatment time periods. A gross and histologic



comparison was made of hematopoietic tissues from mice dying spontaneously, and from those which were healthy at time of sacrifice, among treated animals living 90 days or more.

Theoretical explanations for the experimental findings were advanced.

Microfilm \$2.50; Xerox \$5.60. 112 pages.

## HEALTH SCIENCES, PUBLIC HEALTH

### COLIFORMS AND ENTEROCOCCI AS INDICATORS OF HOUSEHOLD WELL WATER POLLUTION

(L. C. Card No. Mic 60-4253)

Fred Allan Rosenberg, Ph.D.  
Rutgers University, 1960

Major Professor: Dr. H. Heukelekian

Investigations were undertaken to determine the numbers of *Aerobacter*, *Escherichia* and enterococci in household well water supplies and to ascertain to what degree

the numbers of these organisms were affected by climatic conditions and well characteristics.

These investigations consisted of a year's intensive survey of three individual wells, as well as two extensive surveys, at different seasons of the year, of a community depending entirely on wells for its water supply.

Numbers of the various bacteria studied increased as a result of rainfall and higher numbers of coliform organisms in the summer appear to be due to multiplication of *Aerobacter aerogenes* in the external environment.

Deep drilled and driven wells showed less contamination than shallow dug wells. Decreased pollution was also apparent with increased distance from septic tanks.

Enterococci and *Escherichia coli* are fecal in origin and either should be able to serve as an indicator of intestinal pollution. Whereas isolation of *E. coli* is often hampered by the lack of specific methods, a relatively easy determination of enterococci has been made possible through the use of the membrane filter together with a medium highly specific for the enterococcus.

It appears advisable to utilize specific tests both for enterococci and *E. coli* in order to determine recent fecal contamination of well waters, rather than to depend on the Standard Methods technique which merely indicates the presence of coliforms. Until a more specific analysis for *E. coli* is perfected, the enterococcus count appears to be the most easily performed and reliable method for determination of intestinal pollution.

Microfilm \$2.50; Xerox \$6.60. 139 pages.

## HISTORY

### HISTORY, GENERAL

#### GREECE BETWEEN EAST AND WEST: A SURVEY AND AN HISTORICAL INTERPRETATION.

(L. C. Card No. Mic 60-3468)

Spiro Constantinos Manolas, Ph.D.  
Boston University Graduate School, 1960

Major Professor: Frank C. Nowak

Greece's difficulties are not new nor entirely Greek and they became acute, from time to time, as a result of unusual circumstances. Deep problems underlie the fluctuating currents of Greek history, and the Great Powers have been party to many of Greece's difficulties, while Greece's neighbors have been instruments of Great Power machtpolitik in the Balkans.

Greece's tragedy has been fourfold: first, its territory occupies the peninsula which commands an arena of intense political rivalry. Second, since its creation it has been a small and poor nation occupying a strategic geographic position. Third, Greek liberation was made possible by the aid of many Powers that continued to retain their "interest" in Greece. Lastly, Greek nationalism which found fertile soil in the "Great Idea" with the belief that

for survival the little kingdom had to strengthen itself economically and politically by absorbing adjacent lands. These lands, however, more often than not, were inhabited predominantly by Greeks who were faced with absorption or annihilation by a reawakening of Slavic Balkan peoples or nascent Ottoman nationalism. This situation led to a fervent and natural desire for enosis by exohellenes and the historical anagke and almost religious passion felt by the Greek Government to effect a union so long sought after and for so long desired.

From the outset the Greeks were caught between East and West, for Greece's independence and later the extension of its boundaries could be realized only at the expense of Turkey and the policies of Austro-Hungary and England. For Austria, a continental Power, this meant maintenance of Metternich's "consecrated structure"; for England, an insular Power, it meant maintenance of the integrity of the Ottoman Empire since its dissolution would not only disrupt the equilibrium of Europe but its dismemberment would remove the last substantial political bulwark to Russian expansion. It is not surprising that Castlereagh could set aside his doctrine of noninterference in the Greek issue since, as in the Lowlands, its application would have threatened British interests. At the same time, Greece could expect little from Russia, for concessions from that quarter, notwithstanding the Tsarist ruse of protecting co-religionists would be at the expense of Pan-Slavism

and Tsarist expansion. Furthermore, being non-"Catholic," Greece could expect no sympathy from Catholic powers. Finally, her early boundaries, like most boundaries in the Near East, reflected neither a political nor an economic necessity but were drawn to guarantee weakness and rivalry and became an object of power politics. This inherent situation has brought Greece periodic chastisements and unsolicited transgressions by the Great Powers with serious effects on her domestic life as well as her international position.

Historically, Austria-Hungary, England, France, and Germany, individually or in collusion, had prevented Russian domination of the Balkans and the Near East; but recent history proved more favorable to the Soviet Union until Soviet designs against Greece and Turkey after World War II forced the United States to take a series of decisive actions best described as the "Truman Doctrine" which caused international Communism to suffer in Greece its first and only major defeat in the post-war period. As a result, Greece found a new protector in the United States, but at the same time fell more securely into the Western orbit. In 1841, Sir Edmund Lyons, the British Minister to Athens, made the prophetic statement, "A Greece truly independent is an absurdity. Greece is Russian or she is English; and since she must not be Russian, it is necessary that she be English." In 1947, the Truman Doctrine reaffirmed this dictum with the modification that since Greece can not be English, it is necessary that she be "American."

Microfilm \$8.35; Xerox \$29.70. 659 pages.

PORTSMOUTH, NEW HAMPSHIRE:  
THE ROLE OF THE PROVINCIAL CAPITAL  
IN THE DEVELOPMENT OF  
THE COLONY (1700-1775).

(L. C. Card No. Mic 60-3473)

Howard Tredennick Oedel, Ph.D.  
Boston University Graduate School, 1960

Major Professor: Robert E. Moody

Throughout the colonial period the town of Portsmouth directed the life and spirit of New Hampshire. Not only was Portsmouth the major center of population, but it controlled the political and economic activities of the colony. As the provincial capital, Portsmouth also set the standards for the social and cultural patterns of life in New Hampshire.

It has been the intention of this writer to develop a "portrait" of eighteenth-century Portsmouth in all its aspects: political, economic, social, religious, cultural. The date 1700 is an arbitrary choice, but was selected rather than 1630 because the earliest history of Portsmouth has been reviewed many times.

In 1700 Portsmouth looked back on a bleak heritage. Since 1636 when the Proprietor, Captain John Mason, had died, its life had been dominated by Massachusetts. Only the desire of the Crown to prevent the aggrandizement of the Bay Colony, and the desire of the Masonian heirs to retrieve their proprietary claims, kept New Hampshire from being swallowed up by Massachusetts.

Portsmouth assumed the leadership in the inevitable

struggle to win a separate colonial status for New Hampshire. The need for support against the Indians and the Masonians made it difficult to encourage an independent spirit in New Hampshire in opposition to Massachusetts.

Finally, the necessity of settling boundary disputes led to a struggle with Massachusetts from which New Hampshire emerged as a vastly enlarged and separate royal province with a governor of its own: Benning Wentworth of Portsmouth.

Portsmouth's economy in the eighteenth century depended on fish, masts, ships, and lumber products. Its customers were England, the British West Indies, Portugal, and Spain. Coastal-trading and illegal trade with the French colonies and Newfoundland helped make up for the heavy importation of British goods into New Hampshire.

Social life in Portsmouth in the early part of the century reflected the rigors of the frontier, but as time went on the cultural patterns, styles, and tastes of the mother-country predominated. The Wentworths were the pace-setters when it came to social and cultural activities.

Portsmouth's religious life was more casual than other New England communities. Several Congregational Churches vied with each other for parishioners, and there was a small but powerful Anglican Church.

Governor Benning Wentworth managed to marshal his influence and his activities in such a way that for twenty-five years he was politically unassailable. His championing of the royal prerogative won him respect in both England and America, as did his part in the Louisbourg campaign (1745). But his greed for land and for fees, his lack of concern for protecting the King's mast-trees, and his failure to prevent illegal trade led to his downfall.

His successor was his nephew, John Wentworth, who obtained the royal commission in 1766 when he was in England. Young Wentworth's opposition to the Stamp Act made him a popular hero in New Hampshire. Moreover, his views on how to promote the King's interests coincided to a large extent with how best to promote the colony's interests.

Wentworth's care in exercising the royal prerogative, in conciliating differences between England and the colony, in promoting New Hampshire in every way he could, came to nothing, however, when New Hampshire joined her sisters in the revolutionary cause.

Life in Portsmouth during these last years of colonial rule was colorful. The economy flourished, as did all kinds of social and cultural activities, including private schools, lending libraries, fire societies, and newspapers. Black slaves, attired in livery, waited on men and women decked in all the lavish finery of London itself.

Today, there is certainly little of the political or economic life of the eighteenth century in evidence in Portsmouth. The old state house no longer exists, John Wentworth's official residence as Governor has become a home for the aged. Two tug-boats and an excursion boat to the Isles of Shoals, together with a few lobstermen's ketches, make up Portsmouth's twentieth-century fleet. The social customs and religious precepts of several hundred years have largely, and perhaps happily, become metamorphosed quite beyond recognition. But the streets and a surprising number of the homes, buildings, and furnishings of eighteenth-century Portsmouth remain - silent witnesses to an era of prosperity, wisdom, and refinement remarkable, if not unique, in Colonial America.

Microfilm \$12.65; Xerox \$45.20. 1003 pages.



## HISTORY, MODERN

THE RECEPTION OF  
THE FRENCH REVOLUTION  
IN THE NEW YORK STATE PRESS:  
1788-1791.

(L. C. Card No. Mic 60-5272)

Kurt Beermann, Ph.D.  
New York University, 1960

Adviser: Professor Leo Gershoy

There have been several studies on how individual American newspapers reported and commented on the French Revolution. This is the first, however, which presents and analyzes how several American newspapers covered developments day-by-day. This study shows in what way twelve New York State newspapers reported, treated, and commented on the events in France from the November 1787 session of the Paris parlement to the end of the National Assembly in September 1791. (These twelve newspapers represent all but one of the papers presently available without any or with only minute gaps in issues.) This study does not deal with the broader public opinion in America or with the reception of the Revolution by any particular groups or individuals, except as accounts of these factors affect the coverage of the newspapers themselves.

Specifically, the scope of this study includes 1) the presentation of French events by the newspapers, 2) the historical accuracy of the presentation, 3) the sources of news available to the different papers, 4) the treatment accorded to the material, and 5) editorial practices, comments, and interpretations.

Individually differing in degree these twelve newspapers in their composite presentation provided a generous scope of events and a wealth of details. The New York press coverage was largely based on the English newspapers, which supplied material written by Englishmen or for English readers. There were also contributions by French correspondents for English papers and the proceedings of the National Assembly, which the English press copied from French papers. Material reaching the American newspapers directly was far less in volume and included letters to American businessmen from their English counterparts, letters from travelling Americans, excerpts from French papers, and material from the French language *Leyden Gazette*. In addition, the New York press frequently copied from other American newspapers, whose dispatches were derived from various domestic and foreign sources.

In making their selections the New York editors were more often influenced by considerations of space than by the contents of the material. This material was most frequently taken from sources common to all the newspapers. This was clearly shown by the identical dispatches which all the papers printed in reporting major occurrences and in the identical material printed in more than one newspaper for events of somewhat lesser importance.

In contrast to the editorial comments so often found in the English newspapers, the New York editors provided little editorial comment or guidance. New York editorials were most frequently concerned with the reliability of news. They did not take sides as yet with respect to French events; they all favored the progress of the Revolution as

it was described in their pages. But when the Revolution was attacked the New York editors vigorously rose in its defense.

The coverage was generally correct and accurate, although the New York press sometimes misunderstood nuances. This historical accuracy must be acknowledged as must also the quality of reporting of the English press which made this accuracy possible. But if the great detachment on the part of some English writers was responsible for the accurate observations on men and affairs, the enthusiasm of the New York press was responsible for the uniformly sympathetic description of France.

Microfilm \$9.45; Xerox \$33.60. 746 pages.

THE FIRST MEXICAN NAVY,  
1821-1830.

(L. C. Card No. Mic 60-4591)

Robert Leland Bidwell, Ph.D.  
University of Virginia, 1960

The Mexican navy was created for one primary purpose: to aid the nation in securing complete independence from Spain. To accomplish this aim, two objectives were set before the commanders of the navy, with a third task as a corollary. The navy was to force the surrender of the fort on the island of San Juan de Ulúa which was held by Spain when her troops were forced to withdraw from Mexico in 1821, and from which she effectively controlled the shipping in the most important port of the new nation, and to exert such pressure as the navy might have against the shipping of the Spanish Empire, particularly Spanish trade with the island of Cuba. A necessary consideration in both of these objectives was the protection of Mexico from a possible attack from Spain, which would come from Cuba.

Officers for the new navy came originally from the Spanish navy and merchant shipping--either Mexicans in that service, or Spaniards willing to leave Spanish service to cast their lot with the future of Mexico. The navy was planned and formed by the Liberator, Augustín de Iturbide, together with former Spanish naval officers Antonio de Medina and Pedro Celestino Negrete. The execution was entrusted to Eugenio Cortés and José de Aldana, both of whom left the Spanish frigates *Prueba* and *Venganza*, in the harbor of Acapulco during the brief campaign of liberation, to Mateo Plowes, Bonifacio and José María Tosta, Gonzalo de Ulloa, José María Narvaez, and Francisco García, all of whom left the Spanish navy to build the Mexican navy. Cortés was sent to the United States to purchase the schooner *Iguala* and gunboats to be used in the four-year siege of Ulúa, in which task he was aided by the sympathetic merchant Richard Worsham Meade. The sailors of the battleship *Asia* and the brigantine *Constante* mutinied and sold these Spanish vessels to Mexico for the money due them by Spain. Mariano Michelena purchased in England three vessels, which with the *Guerrero*, constructed in the United States, and a few vessels captured for contraband, made up the new navy.

Naval officers in Jalisco and Yucatán played an important role in forcing the obedience of those areas to the federal republic established on the downfall of Emperor Iturbide. The first Mexican naval officer of prominence,

Pedro Sáenz de Baranda, preserved the nascent navy from falling into Spanish hands during a rebellion of Antonio López de Santa Anna in Veracruz in December 1822. A naval academy was established in Tlacotalpam to provide officers for the navy, and the Asia, renamed the Congreso Mejicano was sent from Acapulco around South America to Veracruz to aid the ships there.

Before the battleship sailed, the first task of the navy was accomplished when the fleet prevented a relief force from reaching Ulúa, and the fortress surrendered. British officers brought from England by Michelena with the ships he bought dominated the navy during the crisis in Veracruz, but left the navy when financial support weakened, and an officer of the United States navy was employed to head the navy. David Porter was to have led a combined Mexican and Colombian fleet against Spain, but the Congress of Panama showed the impossibility of either an invasion of Cuba or joint operations. The work of Porter was reduced to harassing Spanish trade, which he attempted for two years, half of that time from a base at Key West.

Internal fighting and economic chaos forced the government to neglect the navy, so that when a Spanish invasion came in 1829 there was no navy operating to oppose it. By 1830 the only ships sailing joined a revolt in Yucatán, and the first Mexican navy died of neglect and lack of purpose. Microfilm \$7.50; Xerox \$26.80. 591 pages.

THE POLITICAL POSITION  
AND DOMESTIC POLICY OF  
ROBERT CECIL, FIRST EARL OF SALISBURY,  
1603-1612.

(L. C. Card No. Mic 60-3551)

Thomas Malcolm Coakley, Ph.D.  
University of Minnesota, 1959

"The Political Position and Domestic Policy of Robert Cecil, First Earl of Salisbury, 1603-1612," is a description and analysis of the last years of Salisbury's political career during the reign of James I. This study is not a detailed account of Salisbury's entire administration but an attempt to evaluate his political position and domestic policy in general terms. Certain aspects of his administration, for example, the management of Parliament and foreign affairs, are largely ignored. To a great extent, Salisbury was the heir of his father's political position and domestic policy. His political methods and objectives had deep roots in the experience of Elizabeth's reign. He found himself unable or unwilling to change the objectives of policy in order to reckon with new political forces royal and parliamentary, which were clamoring for recognition. In spite of changed conditions he helped to preserve certain aspects of Tudor polity until 1610.

Salisbury's political position depended upon his primacy in the king's confidence, his skill in dealing with other politicians, and his labors in the offices which he held. Although his position as a councillor of the Crown was essentially advisory, he used that position with considerable effect in the early years of the reign. Salisbury insisted upon complete loyalty to the Crown among his political allies; and he found his political enemies among those whose loyalty was suspect or whose concurrence with

his political primacy was doubtful. He used ties of friendship and kinship wherever possible, but he was not hesitant to deny his friends or disown his family if he doubted their worth. Salisbury has a great capacity for taking pains over the duties of the numerous offices which he held. As principal secretary of state, lord treasurer, master of the Court of Wards, and as the holder of other lesser offices, he was the first bureaucrat of the realm as well as the principal policy-maker. He had an important part in preferring minor officials to posts in the administration and in encouraging or discouraging suits of private persons. Salisbury's intangible primacy never became a tyranny over Crown, Court, or Council.

In matters of substantive policy Salisbury exhibited his strong attachment to the objectives of Elizabeth's reign. James and Salisbury would tolerate no public recognition of any Church except the Church of England by law established. Basically Salisbury's objection to Catholic recusancy and Puritan nonconformity was the same. Both positions involved unpardonable breaches of decency, order, and good government which were intolerable in a monarchy like England. Salisbury, however, favored flexibility in the implementation of the policy towards recusancy and towards nonconformity, according to the circumstances confronting the government.

In finances Salisbury exhibited a willingness to experiment, which he lacked in other aspects of domestic policy. Finances were primarily a matter of means and not of ends. Salisbury seemed less reluctant to depart from the policy of Queen Elizabeth and of old Lord Burghley. He tried first to stabilize and augment the revenue by the refinement of traditional sources of income. When these proved inadequate, Salisbury showed a willingness to experiment with new correctives for the new problems which confronted the government. The culmination of these attempts was the effort to provide the king with annual parliamentary support in return for the suppression of the burdens of tenancy in chief and the suppression of other grievances. The failure of this Great Contract in 1610 marked the failure of Salisbury's efforts to preserve aspects of the Tudor polity into the new reign. In spite of his intelligence, diligence, and loyalty the objectives of his statesmanship did not prosper.

Microfilm \$5.45; Xerox \$19.15. 425 pages.

OUTRAGEOUS ENCOUNTER!  
THE CHESAPEAKE-LEOPARD AFFAIR  
OF 1807.

(L. C. Card No. Mic 60-4605)

Edwin Metcalf Gaines, Ph.D.  
University of Virginia, 1960

On June 22, 1807, the H.M.S. Leopard forcibly searched the U.S.S. Chesapeake for British deserters from His Majesty's Navy. During the unparalleled attack on a neutral's national ship which took place within sight of the United States coast, three Americans were killed and eighteen wounded. Subsequently four men were removed from the Chesapeake - three of whom were United States citizens and one, a former English sailor who had enlisted under an assumed name.



The Chesapeake-Leopard encounter which is here presented as a case history in Anglo-American relations, was an event of far-reaching significance. In general, it emphasized the many maritime grievances suffered by the young and proud United States of the early 1800's. In particular, it dramatically high-lighted Britain's policy of impressment - the most infuriating of all Britain's policies as far as Americans were concerned.

Unfortunately no historian has fully explored the conditions, circumstances and chance which combined to bring about this unforgettable catastrophe. It was the privilege of this author to uncover heretofore neglected materials which throw new light on the Chesapeake affair. The main sources for this study consist of the exhaustive Admiralty Records and the equally voluminous Foreign Office Papers in London's Public Records Office. In addition, the private correspondence of many influential Englishmen has been vital to the completion of this investigation.

Weighed against American sources, several factors stand out as a result of this study. First, it is evident that the most constant and important source of irritation between Great Britain and the United States from 1793 to 1807 was friction over impressment. The epitome of this was the Chesapeake-Leopard affair.

Second, it is also clearly evident that the power of the Admiralty in the English government increased until in 1807 it was dominant. Following the establishment of Bonaparte's supremacy on the continent, the English Navy became the sole savior symbol of the Mother Country, and not even a Prime Minister could withstand the pressures exerted by the all-powerful Admiralty.

Finally, the unfortunate affair need never have occurred had it not been for Vice-Admiral George Cranfield Berkeley, Commander of His Majesty's Navy on the North Atlantic Station. There could hardly have been a more unlikely choice for a position calling for diplomacy and judicious action. Reinforced by a powerful circle of family and friends, and emotionally anti-American, Berkeley possessed the almost certain knowledge that his personal fortunes would not suffer whatever his policies - even his policy that in June of 1807 brought about the outrageous and momentous Chesapeake-Leopard encounter.

The ironic aftermath of the Chesapeake affair was that when war did come in 1812, the United States, united and determined in 1807, had become a house divided.

Microfilm \$2.50; Xerox \$8.00. 174 pages.

THE TREATMENT OF ENGLAND  
AND ENGLISH AFFAIRS  
IN THE DUTCH PAMPHLET LITERATURE,  
1640-1660.

(L. C. Card No. Mic 60-1763)

Robert Lloyd Haan, Ph.D.  
University of Michigan, 1960

This is a study of Dutch reaction to and opinions of events and developments in England. The attempt is made to look through contemporary Dutch eyes at the English civil wars, the execution of Charles I, the first Anglo-Dutch war and the restoration of Charles II, to determine what attitude was taken toward these events by the various

groups within the Dutch Republic and what connection existed between these events and the situation in the Republic itself.

The polemical pamphlet was the most significant medium available at this time for influencing public opinion. The pamphlets also constitute the best evidence we have from this period for determining what public opinion was on a given matter at a given time. They indicate what arguments were used on each side of a question; they generally reveal which groups in the Dutch Republic took which attitude; and they frequently indicate which attitude was most widely accepted.

The study distinguishes three distinct, coherent and articulate groups within the Dutch Republic: The regents' party or States Party, consisting of the wealthy oligarchs of the leading cities, who wished to see the Estates of Holland dominant in the government of the Republic; the Orangists, who favored the predominance of the prince of Orange in the state; and the strict Calvinists, who took a profound interest in politics but did not consistently support either one of the two political parties during this period.

During the early years of the English civil wars the prevailing sympathy in the Dutch Republic was with the Parliamentary cause. Most pamphlets written by the Dutch themselves about the conflict, as distinguished from translations from English tracts, were produced or prompted by the strict Calvinists, who firmly supported Parliament and felt that the royalist cause represented an attempt to return England to Roman Catholicism.

After 1643 Dutch interest in the English situation declined abruptly until it was revived by the execution of Charles I. The overwhelming reaction to the execution in the Dutch Republic was one of shock, horror and indignation. Not even representatives of the States Party defended the execution in print, although they did deplore the royalist sentiments and theories of divine right which burst out in the Republic in response to the execution and which they felt undermined the theoretical position of their own state.

Pamphlets from the period immediately before the first Anglo-Dutch war show us the picture of a nation straining at the leash to begin a war which its government is reluctant to fight. Dutch people of all groups and classes realized that the prosperity, position, fighting-power and even existence of their nation depended upon seaborne trade, and they were chiefly irritated by English seizure of Dutch ships. During the war period, not one pamphlet suggested that the Dutch were in any way to blame for the hostilities. And almost no pamphlets ventured to defend the new regime in England. Keen hatred for the current religion and the current government of England was common to all groups in Dutch society. The Calvinists as well as the libertines expressed hatred for the Independents; the supporters of the States Party as well as the Orangists expressed loathing for the Commonwealth government.

The Restoration was received with much enthusiasm in the Dutch Republic. As the Commonwealth government had found no defenders during the war, so now the new king found no attackers. Even members of the States Party, although accused of hypocrisy by the Orangists, swam with the tide and flattered Charles II.

Microfilm \$3.70; Xerox \$13.05. 287 pages.

THE IRON KING OF LIÈGE:  
JOHN COCKERILL.

(L. C. Card No. Mic 60-3080)

Theodore Burt Hodges, Ph.D.  
Columbia University, 1960

John Cockerill, a Belgian entrepreneur of metallurgical and textile machine enterprises, created a European-wide industrial empire in the early decades of the nineteenth century. Cockerill, born in England in 1790, migrated to Belgium at the age of 12 to join his father, William Cockerill, a self-taught builder of textile machinery. The elder Cockerill had arrived in Belgium in 1799 at a time when the woolen industry of eastern Belgium was undergoing rapid expansion. William Cockerill was first hired by two Belgian woolen manufacturers of Verviers to construct English carding and spinning machines, hitherto unknown in that region. With capital accumulated from this association, the Cockerill family established a textile machinery factory in nearby Liège. This industry prospered notably during 1807-13, benefitting from the protection afforded by Napoleon's Continental System. William retired in 1813, leaving the Liège plant to his sons, John and Charles-James. The brothers opened a branch plant in Berlin in 1815, began experimenting with steam engine manufacture in the same year, and purchased a chateau and grounds at Seraing, near Liège, in 1817. Charles-James withdrew from the business in 1819, leaving John in full ownership.

The Seraing property, which became the center of John Cockerill's industrial empire, grew in twenty years into the largest self-contained metallurgical and steam engine plant on the European continent. Seraing offered a combination of excellent locational advantages: water communications via the Meuse River directly with the ports of northwestern Europe, as well as access to the skilled industrial labor of the Liège area. Coal seams directly beneath the Seraing plant were exploited and extensive concessions for coal, iron ore, and nonferrous mineral deposits in eastern Belgium were acquired.

In the process of developing the Seraing plant, Cockerill in quick succession exhausted his own capital, arranged for substantial loans from the semi-governmental investment bank, the Société Générale, and, finally, in 1825 entered into partnership with the Netherlands Government by ceding half of his interest in Seraing to the government. As Cockerill was repeatedly on the brink of financial collapse during 1825-30, a series of emergency loans from the government maintained the solvency of Seraing, and paid for the expensive new equipment installed there. Cockerill's success in procuring these loans was due in large part to his close friendship with William I, King of the Netherlands.

After the Revolution of 1830, which permanently separated Belgium from Holland, Cockerill arranged a contract with the new Belgian Government, by which he regained full ownership of Seraing. Payment to the Belgian Government for its half of Seraing was arranged by shipments of rails and locomotives to the Belgian State Railway Administration, which began construction of a national network of railroads in 1835.

In the economic boom of 1835-38 Cockerill expanded his interests by buying industries and shares of stock in coal mines and factories. When the depression of 1838-39 struck, Cockerill was hopelessly overextended financially,

and unable to meet his creditors' demands. A bankruptcy was declared, and the Cockerill holdings passed to the creditors. Cockerill's dramatic sales journey to Poland and Russia ended with his sudden death in June, 1840. Seraing was reorganized as a joint stock company, with the name - Cockerill - attached to the plant.

John Cockerill contributed significantly to the diffusion of English industrial techniques, by procuring English machines and plans, adopting English methods of manufacture, and temporarily employing English engineers and technicians in key positions. Sales agents and machine assemblers of the Cockerill firm in their turn spread the fruits of the English industrial revolution to Spain, Germany, and Poland.

Microfilm \$6.60; Xerox \$23.40. 518 pages.

THE INTELLECTUAL IMPACT  
OF THE TWENTIETH CENTURY  
ON THE CHURCH OF THE BRETHREN

(L. C. Card No. Mic 59-4417)

Herbert Ward Hogan, Ph.D.  
The Claremont Graduate School, 1958

From the confiscation of Christopher Sauer's printing press in 1778 to the last decade of the nineteenth century intellectual activity among the Brethren was at a minimum. By the 1890's, however, there was a veritable renaissance among them. In that decade Brethren were confronted with the problems of urbanization and city missions; they sent their first missionary to the "pagan" world; Brethren colleges granted their first B.A. degrees; the first member of the church earned a Ph.D. degree, and after nearly two hundred years, the Brethren produced the first history of their church.

The years since 1890 have witnessed vast and significant changes in the intellectual life of the Brethren. During these years the Brethren have moved from a sect, isolated from American life, into the main stream of the broader American industrial community. They have been swept from their nineteenth century anti-intellectualism into the currents of American religious and intellectual life. They have developed from their essentially eighteenth century Biblical literalism to an acceptance of the best thought and scholarship in the Protestant tradition.

Early Brethren intellectual activity was scarcely more than the broadening of horizons. During the period 1890-1910 their response to archeological developments provided the most pronounced evidence of their interest in scholarly subjects. A mile-post in Biblical interpretation was passed when, in 1914, the Gish Fund Committee selected for distribution James Orr's The Problem of the Old Testament with its acceptance of "constructive criticism." The struggle of science and religion as it related to Darwinism was not settled so readily. It was not until 1931 that Annual Conference formulated a statement of its official position. This was a cautious, conservative, statement which, however, neither condemned those who accepted evolution, nor specifically upheld the verbal inspiration of the Old Testament.

Building upon the Brethren heritage of social (pietistic) concern Brethren developed a deepening social consciousness



at the turn of the century and some Brethren were being influenced by the Social Gospel Movement by 1910. By the 1920's many of the strongest leaders of the church had accepted a social gospel orientation, though the thirties witnessed an interesting reversion on the part of some of these to a Calvinistic ethic.

The Brethren adopted ecumenicity with a gradual persistency characteristic of Brethren conservatism. Cautiously, yet at times deliberately, Brethren emerged from their cloistered sectarian communities of the nineteenth century into full and active participation with other Protestant bodies. Membership in the Federal Council of Churches in 1941 was the logical result of this development.

Fellowship with the Federal Council also produced a heated debate with the small minority of Brethren Fundamentalists. Though Brethren leadership had not been seriously influenced by twentieth century fundamentalism, Brethren theology had been sufficiently conservative to provide some fertile soil for the movement and to precipitate considerable theological conflict during the 1920's. As early as 1914 P. B. Fitzwater had observed the direction church leadership was moving and had left Brethren circles for Moody Bible Institute. The 1931 decision of Annual Conference on evolution and the 1941 decision to join the Federal Council made the Brethren position more obvious. Furthermore, by the post-World War II period a new synthesis, influenced by Niebuhrian Neo-Orthodoxy, was in the making.

Thus at mid-century Brethren had solved the conflict of liberalism vs. fundamentalism, had become active participants in the Federal Council of Churches, and were more completely abreast, than at any time in the previous one hundred and fifty years, of the religious and intellectual thought of the day. A cycle, beginning in 1890 had been completed. A new one was in the making.

Microfilm \$5.90; Xerox \$20.60. 461 pages.

#### THE JUDICIAL PHILOSOPHY OF CHIEF JUSTICE TAFT AND ORGANIZED LABOR, 1921-1930.

(L. C. Card No. Mic 60-4105)

Stanley Ira Kutler, Ph.D.  
The Ohio State University, 1960

William Howard Taft was appointed Chief Justice of the United States in June, 1921, and remained on the bench until February, 1930. In that period, he played a prominent role in defining labor's relation to the law. This work discusses and analyzes Taft's judicial and legal philosophy as brought out in his labor opinions.

Taft belonged to the analytical school of jurisprudence and did not believe in seeking out new paths in law. What he sought to do was to formalize the concepts of the past and lend exactness where vagueness persisted. But he never realized the futility of his "yearning for the absolute." Social and economic conditions are ever changing. It is idle to attempt to systemize and regulate them with rigid laws. Taft, however, believed that the law dictated and ordained the correct social and economic theories; he never did see that law evolved from the current and acceptable social and economic theories.

In the Steel Foundries Case (1921), the Chief Justice recognized that each case must turn on its own circumstances, but he nonetheless tried to set forth a judicially acceptable method for dealing with all picketing. He knew that the lower courts would accept his formula of one picket for each entrance to a struck plant. His naive and unrealistic formula, however, was discarded in the next decade.

In Truax v. Corrigan (1921), he sought to apply what were really new tort liability rules as fundamental rights. Speaking for the Court, he rejected the Arizona Anti-Injunction Law, and attempted to discourage any similar future legislation with a doctrinaire discussion of due process, equal protection of the laws, and business as property. The whole question of legislative interference with property came to a head in the Wolff Packing Co. case (1923). Although compulsory arbitration was rejected, Taft's opinion established a grandiose formula that limited the right of a state to regulate business. The opinion temporarily stifled such state action, but ten years later, a more realistic Court rejected his efforts.

Taft refused, because of his rigid view of the federal system, to admit the power of the national government to regulate child labor. As a private citizen he opposed such a law based on the commerce power and, in 1922, wrote the Court's opinion rejecting a similar law based on the taxing power. He attempted to delineate clear spheres of federal and state powers, and was confident that he had settled the child labor question for all time. Again, in the 1930's, the finality of his doctrine was rejected.

In the Adkins minimum wage case of 1923, he dissented from the Court's ruling that minimum wage legislation was an unconstitutional interference with freedom of contract. Taft's position illustrated the futility of categorizing social legislation as he agreed that freedom was the rule and restraint the exception, but he found that the minimum wage law was not an improper exception.

William Howard Taft's work in labor law generally proved to be ephemeral. There was much that he attempted but very little has survived the years. Most of his ideas were rejected because they proved to be unrealistic and outmoded for future generations. That is the irony of Taft's judicial career in labor law; no man tried so diligently to settle questions for the future, but yet accomplished so little that has been enduring and useful.

Microfilm \$3.45; Xerox \$11.95. 265 pages.

#### THE HUMANITARIANS AND THE UNITED STATES NAVY, 1798-1862.

(L. C. Card No. Mic 60-3666)

Harold David Langley, Ph.D.  
University of Pennsylvania, 1960

Supervisor: Dr. Roy F. Nichols

This study of the impact of nineteenth century humanitarianism on the personnel policies of the United States Navy deals in particular with the movements to abolish the traditional spirit ration and punishment by flogging. These movements, aspects of larger movements for

temperance and penal reform, were strongly influenced by the Navy's need for men, particularly American born men. Many measures were proposed to meet this need, but critics of the Navy repeatedly argued that no reform could succeed so long as the two basic problems of drink and corporal punishment were neglected.

Before the Congress abolished flogging in 1850 and the spirit ration in 1862, it passed laws which largely rectified a number of other grievances connected with the naval service. Orders issued by various Secretaries of the Navy also attempted to correct specific abuses. These gains, plus the acts abolishing flogging and grog, were codified and promulgated in 1862 through naval regulations and acts for the reorganization and the government of the Navy. The foundations were thus laid for a career enlisted service. Provision also was made for enlisted men with the necessary talent and ability to become officers through appointments to the Naval Academy from the fleet. These changes, the naval counterpart of the rise of the common man, were brought about largely through the efforts of a few reform-minded members of Congress, naval officers, chaplains, and Secretaries of the Navy.

The most important organization which helped the cause of naval reform was the American Seamen's Friend Society, organized in 1826. To save the sailor's soul, and his money, as well as to improve the conditions of his employment, the Society attempted to control his environment. It established churches, banks, boarding houses, libraries, and an employment registry office, all dedicated to the needs of the sailor. Overseas stations were established in a number of foreign ports to care for him while he was abroad. The Society also successfully petitioned Congress for an increase in the number of Navy chaplains, and several of the new appointees worked with the Society to attain its goals. The Society's monthly publication, *The Sailor's Magazine and Naval Journal*, had an extensive circulation in the Navy. Through its chapters and affiliated organizations the Society kept abreast of a wide range of maritime reform activities. Besides publicizing and encouraging such activities the Society urged its friends to petition members of Congress for reforms. The organization itself was not connected with any political faction or party, but appealed for support on the basis of religious and humanitarian ideals. It was both non-party and non-denominational. There was a direct connection between the Society and some of the most important figures in the anti-flogging and anti-grog campaigns.

In the last analysis, success hinged on convincing the members of the Senate Committee on Naval Affairs that the reforms were desirable. Flogging was defended as indispensable by politicians and officers. The discontinuance of grog was opposed because the spirit ration did not in itself cause drunkenness and because ending the ration was regarded as an unwarranted interference with human liberty. In the case of both flogging and grog the final victory was won by a few reforming Senators, partly because the majority of the Congress was distracted by other issues relating to the slavery question and to the preservation of the Union.

Sources for this study included the files of *The Sailor's Magazine*, the *Army and Navy Chronicle*, and other nautical periodicals, the reports of the Secretaries of the Navy, the official records of the Navy Department in the National Archives, and the papers of various naval officers, Secretaries of the Navy, and members of Congress.

Microfilm \$4.85; Xerox \$17.10. 380 pages.

## THE POLITICAL CAREER OF II NAOSUKE

(L. C. Card No. Mic 60-3104)

Edwin Borden Lee, Ph.D.  
Columbia University, 1960

Ii Naosuke (1815-1860) served as Great Councilor (*tairō*) of the Tokugawa military government in Japan from 1858 to 1860. He attempted to utilize the dictatorial authority of his office, the most powerful in the Tokugawa bureaucracy, to preserve the government against encroachments by an outside group bent upon gaining political control of Japan. At the same time foreign pressure compelled him to abandon Japan's long-standing policy of isolation and conclude unequal commercial treaties with the West.

Ii had previously sought approval for the treaty-signing from the Emperor in Kyoto, but when imperial approval was not forthcoming, Ii concluded the treaties anyway, fearful that Japan would be subject to attack if she did not grant the foreign demands.

Ii's enemies immediately branded his conclusion of the treaties without imperial sanction as an insult to the Emperor and a compromise of the Tokugawa Shogun's traditional obligation to "subdue barbarians." Some of Ii's enemies honestly disapproved of the treaties; others seized upon them as a means of embarrassing Ii and the bureaucrats whom he represented.

Leading the opposition to Ii was Tokugawa Nariaki, a relative of the Shogun, who sought to reform the military dictatorship of his family in the belief that only reform would enable the Tokugawa government to continue. Nariaki had allied himself with groups which sought to undermine rather than reform the government but which agreed that power must be wrested from Ii Naosuke.

The simplest way for Nariaki and his colleagues to gain control of the government would be to fill the office of Shogun, traditionally a sinecure but actually superior to the Great Councilor, with an individual who shared Nariaki's convictions. An opportunity to do this existed in the necessity for the childless Shogun Iesada to adopt an heir, for Tokugawa Nariaki had an adult son who was eligible for shogunal adoption.

Before an adoption could be arranged, however, Ii Naosuke secured the nomination of a young boy as heir to Shogun Iesada. When Iesada died in the summer of 1858, therefore, Ii remained the most powerful man in the government, completely dominating the new child Shogun.

Ii then set about to eliminate his opposition through a widescale purge. He began by confining Tokugawa Nariaki and his principal supporters. For the most part, however, the victims were men of lower rank who suffered more severe punishments. These men, encouraged by Nariaki and others, had initiated a movement to involve the imperial court in shogunate affairs, a clear violation of the Tokugawa governmental system.

The ultimate result of Ii's purge was his own death on March 24, 1860, at the hands of men who regarded Tokugawa Nariaki's punishment as a personal affront. The assassination brought to an end what proved to be the last major effort to revitalize the moribund Tokugawa shogunate.

Ii Naosuke has been called a traitor because of his insistence that the Tokugawa government could act independently, without deference to the imperial court. This dissertation suggests, on the contrary, that Ii was not a



traitor but a patriot, as he understood the term. To him the Tokugawa government constituted the only legitimate governing body for Japan. Its actions were not subject to review by any outside body. Any attempt to change the government, whether through strengthening the position of the Shogun or asserting the authority of the Emperor, was therefore wrong. To preserve the Tokugawa system and, as he understood it, the nation, Ii Naosuke devoted his political career and sacrificed his life.

Microfilm \$2.60; Xerox \$9.00. 200 pages.

**THE EMANCIPISTS FROM PRISON TO FREEDOM:  
THE STORY OF THE AUSTRALIAN CONVICTS  
AND THEIR DESCENDANTS.  
(VOLUMES I AND II).**

(L. C. Card No. Mic 60-4107)

Paul Edwin LeRoy, Ph.D.  
The Ohio State University, 1960

Overcrowded jails, the American Revolution, and the failure of an African penal colony led to a unique white settlement on the edge of Asia. This study attempts to present an over-all view of the Australian emancipists, their contributions, problems, relations with the nonconvicts, and their adjustments in a land quite different from that in which they were born. There were two groups of ex-convicts--those freed by expiration of servitude and those who were pardoned. Together they dominated the first years of colonial development through their energy, industry and skills. Most of them were former thieves from English and Irish towns. Few were political prisoners and less than half were women. They became the laborers, farmers, and merchants of Australia. They became the shepherds and the stockmen. They carried on the inland transportation and supplied the cedar. The peasant concept of ex-convict grantees, the tenant system, and share crop schemes were based on their presence. Willing to live alone in crude shelters, they acquired knowledge of the bush and the pastures which was of inestimable value to later settlers. Moreover, they helped to build the towns, roads, and wharves. They were among the founders of Australia's free economy. Lord, Underwood and Kable established profitable shipping, textile, and whaling enterprises. They helped to found the Bank of New South Wales. Most of the teachers, doctors, and newspaper men came from their ranks. Isaac Nichols served as the colony's first postmaster. Many served the explorers who went inland. Others helped to maintain law and order.

Anxious to atone for their past errors, they embarked upon energetic careers, contributing to the material advancement of the colony. Their values, mores, and language permeated the ranks of the colonists. Their ideas of morality influenced the contemporary social and criminal problems. The years of transportation and assignment had taught them the prudence of maintaining an outward sense of civil conformity despite excessive drinking and sexual looseness.

They believed that the Crown had transported them to give them a chance to start life over again. They wanted social admittance into the highest circles of society and

political rights and privileges equal to those held by free Englishmen in the various British colonies. But society was divided between the free and the freed. The free, fearing a radical upheaval, preferred the establishment of a narrow legislative assembly to the extension of self-government. The emancipists wanted the right to act as attorneys, to sue, to hold property, to serve on juries, and to become members of colonial legislatures. The exclusives maintained a sharp class distinction and wanted the ex-convicts to become their laborers and tenants. Governor Macquarie had tried, like Governor King, to encourage reform among the convicts. The Crown had not consigned them to disgrace forever. But Brisbane failed to maintain control of the colony, and his successor, Governor Darling, was too conservative. Not until the arrival of Governor Bourke were the convicts' chances to participate on the juries and in the elective franchise increased.

By 1840 the ex-convicts no longer dominated the Australian scene. The dreams of the emancipists and the ambitions of the exclusives had been superseded by problems associated with the rapidly increasing number of immigrants. The end of transportation to New South Wales meant that they would never be in a majority again.

Microfilm \$7.85; Xerox \$27.90. 620 pages.

**SIR GUY CARLETON AS A MILITARY LEADER  
DURING THE AMERICAN INVASION  
AND REPULSE IN CANADA, 1775-1776.  
(VOLUMES I AND II).**

(L. C. Card No. Mic 60-4108)

Perry Eugene LeRoy, Ph.D.  
The Ohio State University, 1960

This study brings to light the numerous problems which confronted Sir Guy Carleton in order to indicate both his capabilities and his faults. His policies toward the different populations of Canada, his logistic, naval, manpower, prisoner of war and antiespionage activities, combined with his tactical and strategic abilities, signify that he was neither a hero nor a scoundrel. Rather he was limited by his superiors, by shortages of materials, by geography and his own prejudices. Nevertheless, he was a worthy opponent for the invading Colonial army in 1775.

Carleton was not able to overcome his favoritism toward seigneurs and his distrust of the English-Americans. Consequently, he was faced by a dilemma, the need to raise a militia among a people who were either apathetic or hostile toward the seigneur class. Yet, in spite of his initial defeats, the Governor did have partial success because of American mistakes. The first four chapters trace the military operations in Canada, forming the background for other pressing issues.

If Carleton did not completely solve his numerous problems, the blame must be shared by his superiors in London. But his want of tact did not absolve him of his own responsibilities. He sincerely believed that a humane policy was better than one of vengeance, especially in regard to prisoners of war.

The most controversial part of Carleton's career, however, concerns his expulsion of the invaders and his

naval operation upon Lake Champlain. There is much evidence to indicate that he wanted to capture the Americans, but unfavorable winds, a shortage of boats, and an alert enemy prevented success. Carleton cautiously refused to expose his advancing columns to possible counterattacks. The significance of geography, distance, and a command divided by an ocean resulted in inconclusive victories.

As for the fall naval operations, the traditional devolution of command upon subordinates of unequal ability did not excuse Carleton from his responsibility for terminating the campaign. Though his naval tactics were faulty, he, nevertheless, had sufficient reasons for his actions. Inexperienced as a naval commander, he pursued the contemporary practices of the British army. At best, one can only speculate on what might have been if winter had not been so close, if there had been enough boats, or if the winds had been favorable. The Governor understood the capabilities of his own troops as well as those of the Americans far better than did Lord George Germain, who exhibited an unusual ignorance of American geography, climate, and social problems.

The dissertation concludes with an examination of winter activities in 1776 - 1777. Canada had to be protected from potential attacks, and the troops garrisoned. Carleton, anticipating an invasion of New York in the spring, collected vessels, equipment, and personnel with the obvious design of avoiding past errors. Success, however, depended upon the support of his superiors who had already selected a more dashing and aggressive leader. Rash optimism replaced guarded caution and terminated in the loss of a British army at Saratoga.

Microfilm \$8.70; Xerox \$31.05. 687 pages.

POPULATION MOVEMENTS  
IN THE POLISH PROVINCES OF  
PRUSSIA, RUSSIA AND AUSTRIA,  
1870-1914:

POLICIES AND ATTITUDES.

(L. C. Card No. Mic 60-3029)

Benjamin Peter Murdzek, Ph.D.  
The American University, 1960

What began as a statistical-national study of movements of Polish population in the Polish provinces of Prussia, Russia and Austria, because of the questionability of the statistical data available and the limitations inherent in a nationality criterion, became an analytical historiographic study of the policies and attitudes which, directly or indirectly, by design or accident, affected the various shifts of the general population living in that area of east-central Europe during the period between 1870 and the outbreak of World War I. The distinction between policies and attitudes was made to distinguish between measures implemented by fiat or legislation by the ruling political authorities and, though not as coherent and effective, the attitudes on migrations as expressed by the traditionally influential Polish leaders in the various sectors concerned. The former had the authority of official sanction, the latter, especially in the Russian and Prussian Polish provinces, was without it and therefore limited to social-economic

influence of the pressure or interest groups concerned. Except, to a degree, in Galicia, the Polish leadership, lacking political-administrative authority, could not implement their wishes legally.

Within this definition, such policies as the German colonization program in the Eastern Marches and the policies relating to foreign immigration into that area of the Reich were considered. The former, though essentially intended to arrest the emigration of German-speaking elements, indirectly facilitated the emigration of the Polish-speaking elements in the interest of national security. For the same reasons, immigration from the Russian and Austrian Polish provinces was at first unrestricted, then completely halted and subsequently, because of the economic needs of Prussian agriculture, rigidly controlled. This section also included the counter-measures attempted by the Polish national groups.

In Russian Poland, within the same definition of policies, a consideration of such varied measures as tariff schedules and their relation to the industrial growth of that area, reprisals against revolutionaries, Russian colonization programs, the May Laws in the Western Governments and the operations of the Peasant Bank were considered. A consideration of attitudes of the articulate Polish groups included their stand not only on the official policies directly affecting population movements but also such measures as peasant credit facilities, the break-up of landed estates (parcelation). Because the emigration movement to Brazil which developed during the period 1890-1892 evoked the expression of the whole spectrum of Polish attitudes and opinions on emigration, that manifestation was treated in greater detail.

In Galicia, because of the relative degree of autonomy which the residents enjoyed, the various attitudes and opinions, when legislatively implemented in the *sejm*, became official policies and measures. For this reason, the distinction between policies and attitudes was less apparent except when the latter were expressed by political, ethnic or economic minorities or where the former were restrained or invalidated by the imperial authorities in Vienna. This section included the deliberations in and actions of the *sejm* in Lwow on such issues as peasant credit facilities, provincial employment bureaus, entail legislation, parcelation, education and industrialization. In Vienna, it included policies relating to conscripts and the attempt to regulate emigration in the imperial economic and political interests. Insofar as possible, some attempt was made to discover the motives of the various segments of Galician political opinion on the various measures which seemed to be related to the movements of population.

During the period covered, the various policies of the ruling authorities changed according to the changing needs or interests of the authorities involved. Such was also the case with the various Polish attitudes concerning the movements of population. In Galicia, where these two most nearly coincided, as well as in the other sectors of prewar Poland, a distinct transition was affected on both in the last decade of the nineteenth century by such developments as the growing temper of nationalism, the failure or impracticability of the older restrictive measures and attitudes and the emergence of inchoate spokesmen articulating the interests of the peasantry and the middle class. The transition in the various Polish attitudes was especially apparent from an examination of the journalistic and



monographic literature analyzing the causes and effects of the various migrations.

Microfilm \$5.95; Xerox \$20.95. 465 pages.

# THE TURKIC PEOPLES OF SOUTHERN IRAN

(L. C. Card No. Mic 60-3122)

Pierre Oberling, Ph.D.  
Columbia University, 1960

Following the fall of the Sassanid dynasty and the Arab occupation of Persia, an ever-increasing flow of Turkic people poured into the Near and Middle East. This migration reached its apogee in Saljuqid times, when entire tribal confederations moved westward from their Central Asian pasture grounds. The Turkic newcomers were vigorous and war-like, and from the very start they played a dynamic role in the political life of the countries in which they settled.

In Persia, the Turkic tribes established themselves in the mountainous periphery of the country. From the Saljuqid to the Pahlavi period they provided Persia with most of its rulers and formed the core of its army.

In this dissertation I have described the Turkic tribes of southern Iran as I found them during a stay in this area in 1957. I have related their history and endeavored to explain why certain of their confederations have disintegrated, while others (in particular the Qashqā'is) have survived for centuries as highly cohesive units. To my own observations, I have added a large amount of material from travel books, official documents and manuscripts.

In southern Persia one finds Turkic tribes from Shushtar to points well to the east of Kermān. In Safāvid times a substantial group of Afshārs inhabited Khuzistān. But some two centuries ago these Afshārs were dispersed. Today there are only two small Turkic enclaves in the province: the Gunduzlu tribe, which dwells in the vicinity of Shushtar, and the Aghāch Eri tribe, which lives around Behbehān. Both tribes are sedentary and have lost their traditional political organization.

In Kermān province there are several powerful Turkic nomadic tribes. Chief among these are the two Afshār tribes and the Buchāqchis. These nomads have preserved their traditional way of life and have remained thoroughly intractable. But they have suffered greatly from internal squabbles and bloody rivalries. Unlike their neighbors in Fārs, they have never formed a confederation.

In Fārs there are two large Turkic tribal confederations, the Qashqā'i and the Khamseh, as well as several lesser Turkic tribes. Although there is a tendency for all the tribes in Iran to become sedentary, upwards to 300,000 Qashqā'is and Khamsehs are still nomadic, some of them covering a distance of 350 miles in their semiyearly migrations. The Qashqā'is and the Khamsehs play an important role in the Iranian economy. They provide the sedentary population with animal hides, leather, meat, milk, butter, cheese, yoghurt, charcoal, gum tragacanth, rugs, carpets, blankets, feed bags, and the finest horses in Iran. Until recently they had an efficient administration and an excellent military organization.

The etymology of the name "Qashqā'i" is still obscure,

and we do not know anything concerning the origin of the Qashqā'i Confederation. The earliest document which mentions the Qashqā'is dates from the reign of Karim Khān Zend, and from it we learn that the confederation already existed in the reign of Nādir Shāh. But there is no dearth of information on the subsequent periods of Qashqā'i history.

The Qashqā'is have had many able and enterprising leaders. This accounts for their longevity as a tight-knit confederation. But their aggressive and recalcitrant behavior has alienated practically every Persian ruler since Nādir Shāh. In this perennial conflict with the Central Government the Qashqā'is have held their own, winning most of the battles and collecting much booty. In the twentieth century, however, they have had to face an increasingly strong, well trained and well equipped Central Government army. As the balance of power began to shift towards Tehrān, they have sought foreign alliances. In World War I and II they sided with Germany. In 1946 they made common cause with Great Britain. At the same time, they were cultivating a friendship with the United States. But by supporting Mosaddeq, they jeopardized their friendship with the Western powers, and when the Shāh crushed the National Front in 1953, they found themselves totally isolated. Since then, they have lost the initiative to the Central Government, which has exiled their leaders and confiscated their properties. As a tribal confederation is only as strong as its leader, the future of the Qashqā'is depends upon whether or not the Qashqā'i leaders will ever again manage to return to Fārs.

Microfilm \$5.80; Xerox \$20.75. 456 pages.

# INNOCENT GENTILLET: A STUDY OF THE CONFLICT OF POLITICAL THEORIES IN FRANCE DURING THE WARS OF RELIGION.

(L. C. Card No. Mic 60-2614)

Charles Edward Rathé, Ph.D.  
Syracuse University, 1960

In this thesis an attempt is made to rediscover a neglected French personality of the last half of the sixteenth century. Briefly referred to in discussions on Machiavelli's political and literary influences, Innocent Gentillet still remains an unknown figure to many students and scholars. It is our contention that Innocent Gentillet, far from deserving this neglect, is a most interesting representative of his age, its preoccupations, attitudes, doubts and dilemmas.

It is not the intention of this study to delve into the biographical and bibliographical problems related to Gentillet; the little which can be known seems to have been quite adequately investigated by Hanns Josef Schäfer in a doctoral dissertation presented at Bonn University in 1929. However, Gentillet's writings, which have been either neglected or misjudged, offer a great deal of interesting material relevant to the latter half of the sixteenth century in France. The special focus of this study is toward the political problems of these tumultuous and tragic years.

Innocent Gentillet, as a distinguished lawyer of Custom

and as a persecuted Protestant, wrote a prodigious amount of material relating to law, politics and religion. Furthermore, he seems to have been an influential and controversial figure in his own time and to have set the style for much of the anti-Machiavellian polemic. Through his two *Remonstrances to Henri III*, his *Apologie for Christians of the reformed faith*, his *Concile de Trente* and his *Anti-Machiavel*, he reflected and expressed himself with conviction and energy on most of the pressing and inflammatory issues of his day.

This study places Gentillet against the background of his time and discovers what influences worked on the intellectual and emotional make-up of this fiery lawyer. Using his writings, it attempts to demonstrate the positive elements of his thought and his contribution to political speculation. Chapter II deals with the role of humanism in the intellectual development of Gentillet. His broad knowledge of classical and biblical literature and his legal education are important factors in his conservatism and in his attachment to *speculum principis* principles. His adherence to a religious minority as well as his suspicion of the absolutist tendencies of Roman law led him to interesting expressions of political liberalism, almost to an assertion of popular sovereignty. It is in Chapter III that this study considers the Calvinism which forced a contradiction in Gentillet and was responsible for his outbursts against constituted authority while acting as a conservative check. This paradox is no less remarkable than the excessively abusive and intolerant diatribes against his real and imagined enemies on the one hand and his insistent pleas for mutual tolerance in religious matters on the other. Chapter IV looks at Gentillet in relation to that sixteenth-century phenomenon of nationalism. His national fervour expressed itself negatively in partisan and vitriolic attacks on the papacy, Italy and Italians but it also expressed itself in Gentillet's sensitive understanding of French history, law and traditions.

Taking issue with those who have seen his most influential work, the *Anti-Machiavel*, as a mere polemic pamphlet, a *livre de circonstance*, this study argues that it was in reality a well-considered and scholarly, if sometimes wrong-headed and superficial rebuttal of Machiavelli's political philosophy. Admitting many weaknesses in Gentillet's reasoning, it attempts to answer the biased abuse directed at him by those who have been hypnotized by Machiavelli.

In short this study interprets and wherever possible presents the writings of Innocent Gentillet which so clearly mirror the divergent tendencies of late Renaissance thought. A marked conservatism, a tendency to seek stability in absolutist forms of government, find themselves side by side with expressions of revolutionary political views and inspiring arguments for liberty of conscience and religious tolerance which were to echo forth in Europe in the eighteenth century. Innocent Gentillet is not a major figure in French literature of political thought, but he does deserve as much attention as other contemporaries such as Hotman and Duplessis-Mornay. He does not deserve the neglect and the ill-treatment which has been his posthumous lot.

Microfilm \$2.60; Xerox \$9.00. 197 pages.

# THE OLD REPUBLICANS: SOUTHERN CONSERVATIVES IN CONGRESS, 1806-1824.

(L. C. Card No. Mic 60-4616)

Norman Kurt Risjord, Ph.D.  
University of Virginia, 1960

The "old Republicans" were the conservative wing of the Republican Party, a small group of statesmen who took to heart the compact theory of government and its corollaries of economy, simplicity, and severe limitations on the power of the central government. Though the term is normally applied to the Congressmen who opposed the nationalism that followed the War of 1812, that group had ties, both in personnel and in political principle, with earlier and later conservative movements within the Republican Party. This work is a history of the conservative wing of the Republican Party from the "Quid" schism of 1806 to the 1820's when the conservatives were absorbed, first by the Crawford "Radicals," and then by the nascent Democratic Party.

The story begins with a summary of the discontent within the Republican Party during Mr. Jefferson's first term in office -- dissatisfaction with his moderation toward the Federalist system, with his compromises in regard to banks and internal improvements. This dissatisfaction broke into the open in the "Quid" schism of 1806 when a small group of ten or twelve members of Congress followed John Randolph in opposition to the Administration in regard to the Yazoo Compromise, the attempt to purchase West Florida, and the policy of economic coercion against England and France. The "Quids," with some local support in Virginia, supported James Monroe against Madison in the election of 1808 and virtually disappeared as a significant faction after Monroe's defeat.

Only a few conservatives had followed Randolph into open opposition, and the Old Republicans continued to dominate the party through the first two years of Madison's administration. The Eleventh Congress habitually approached its various problems -- foreign affairs, military preparation, re-charter of the Bank of the United States -- within the context of Jeffersonian dogma. By 1811, however, the conservatives had come to the conclusion that the system of commercial retaliation had failed and that a more vigorous foreign policy was necessary to uphold the honor and integrity of the nation. In the Twelfth Congress the Old Republicans submitted to the leadership of the "warhawks" and enabled the "warhawks," who were actually a minority in the House of Representatives, to carry the nation to war. Through the War of 1812 the conservatives loyally supported the Madison administration, though they rebelled against occasional proposals that involved too radical a departure from the Jeffersonian system, such as vast appropriations for the navy and military conscription. As soon as news of peace arrived in 1815 the conservatives, led by Nathaniel Macon and John Wayles Eppes spear-headed a move to reduce the military and naval establishments to the level maintained through the first administration of Jefferson.

Through 1816 and 1817 the Old Republicans hardened into an identifiable but very small (about ten) faction under the leadership of John Randolph, Phillip Pendleton Barbour, and John Tyler of Virginia that opposed the bank, the tariff,



and federal internal improvements. In the Fifteenth Congress (1817-1819) the Old Republican group in Congress increased to about thirty, due primarily to a conservative reaction in Virginia led by Spencer Roane, Thomas Ritchie, and the Richmond Junto. In the Missouri debates of 1820-21 the Old Republicans were in the forefront of the Southern defense, and the more extreme states rightists, like Randolph and Macon, voted against the compromise because they opposed the conditional admission of Missouri.

During the 1820's the Old Republicans were gradually absorbed into the "Radical" faction, though they may be distinguished from other elements of the Crawford wing -- economic liberals like Martin Van Buren and the recent converts to states rights in the lower South. After 1824 the Old Republicans, led by John Randolph and Littleton Waller Tazewell (former "Quids") in the Senate and Phillip Pendleton Barbour and Andrew Stevenson in the House, gradually moved into the Jackson party under the influence of Van Buren. After 1829 the Old Republicans found the Jackson Party dominated by the same Northern entrepreneurial interests that they had opposed in the Republican Party. Some, like John Floyd and L. W. Tazewell of Virginia, followed Calhoun out of the party in 1831, while John Tyler broke with Jackson on the bank issue. Most of the Old Republicans, however -- Randolph, Macon, Barbour, and Ritchie -- remained loyal to Jackson largely through lack of an acceptable alternative.

Microfilm \$6.65; Xerox \$23.65. 524 pages.

**BUSINESSMEN IN REVOLT:  
CHICAGO 1874-1900.**

(L. C. Card No. Mic 60-4790)

Sidney I. Roberts, Ph.D.  
Northwestern University, 1960

*Businessmen in Revolt: Chicago 1874-1900* by Sidney I. Roberts deals with the role of businessmen in reforming

Chicago's government during the last quarter of the Nineteenth Century. Its focus is on the major civic reform organizations and crusades of the period. Although not written to defend or attack a point of view, the narrative clearly indicates that Chicago's businessmen took the lead in local reform movements and did not conform to the stereotype which has the businessmen of this era motivated solely by economic dictates.

The narrative begins in 1874 with the formation of the Citizens' Association of Chicago and its efforts to obtain a revised charter for the city. Subsequent chapters deal with the founding of the Chicago Union League Club, the Civic Federation, and the Municipal Voters' League. The author relates how these organizations crusaded successfully for ballot box reform, honesty in the administration of county affairs, the adoption of the merit system, and for the regeneration of the City Council. The story of municipal reform is concluded by an account of how all the aforementioned civic agencies cooperated in 1898 in an effort to regulate the method by which Chicago granted franchises to public-service corporations. This last battle, depicted as the greatest crusade of the entire period, was waged in both Chicago and Springfield and resulted in the defeat of Charles T. Yerkes, Chicago's one-time undisputed traction king.

In a brief concluding chapter, *Businessmen in Revolt* departs from its previous pattern of narrating specific events and makes an attempt at analysis. Here the author has addressed himself to the question of reform motivation. Businessmen, according to this study, participated in civic reform movements because of a variety of reasons. The most important motivating factors were self-interest, religion, a sense of debt to the community, civic patriotism, delegated leadership, and clique activities.

*Businessmen in Revolt: Chicago 1874-1900* terminates by asserting that Chicago's businessmen were a heterogeneous group containing both saints and sinners. They were an important segment of society and cannot accurately be portrayed with either the tar barrel or the white-wash bucket. Microfilm \$3.70; Xerox \$12.85. 285 pages.

## HOME ECONOMICS

**THE IDENTIFICATION OF SOME CONCEPTS  
OF ADOLESCENT DEVELOPMENT HELD BY  
PROSPECTIVE HOME ECONOMICS TEACHERS  
AND THE RELATIONSHIP OF THESE CONCEPTS  
TO CERTAIN BACKGROUND FACTORS**

(L. C. Card No. Mic 60-3764)

Marie Banks, Ed.D.  
New York University, 1960

Chairman: Professor Henrietta Fleck

This study, exploratory in nature, was primarily an investigation of concepts held by prospective home economics teachers regarding adolescent development. It examined the relationship of these concepts to certain

personality and background factors. Sixty-three women, home economics education majors in their junior or senior years at the State University of New York College of Education, Plattsburgh, New York, were the subjects of the study.

The concepts were categorized as being restrictive, laissez-faire, or developmental. The concepts sought were those concerned with one of the developmental tasks of adolescents.

Two inventory forms were developed for this study with the advice of a Board of Judges and were tried out in a pilot study. Form A of these inventories consisted of a series of general statements regarding adolescent development. These statements were related to seven "status-giving" areas and were then arranged in spirals of seven to secure reactions to each item separately.

The second inventory, Form B, was based on the film "Farewell to Childhood." Students, after viewing the film, were given this second inventory which consisted of brief descriptions of scenes in the film with a choice of one of three possible reactions.

Responses to Form A showed that these students were most developmental in their concepts regarding scholastic attainment and religious groupings. There was a tendency toward restrictive concepts regarding dress and grooming, while the tendency was toward laissez-faire in the areas of health and social status. There was some tendency to confuse laissez-faire and developmental concepts. Ambivalence was indicated in the concepts toward racial and money status.

A study was made of the association of responses to Form A and to scores on the Minnesota Teacher Attitude Inventory (MTAI), the instrument selected as a measure of personality, and to scores on the Selective Admissions Examination (SAE). A similar study was also made in terms of family background factors including social class, education of parents, number and sex of siblings, and ordinal position of the participant in her family.

Those students ranking highest on developmental concepts were also in the upper group on MTAI. At the other end of the scale, those ranking in the lower group on MTAI were in the upper group on restrictive concepts. Since

MTAI was designed to indicate a scale ranging from teachers able to maintain harmonious relations with pupils to those who dominate the classroom, it was clear that these two instruments were operating in the same direction.

The only observed relation between concepts and scores on SAE was that students ranking high on SAE were in the upper group on restrictive concepts. The reason for this is not clear. One obvious explanation is that the SAE attempts to rank persons according to academic attainment rather than on the basis of concepts.

It was gratifying to find that, in general, these prospective home economics teachers were highly developmental in their concepts. This fact was particularly evident in their responses to Form B. Here there was such a general acceptance of those items indicative of developmental concepts that the results did not lend themselves to statistical study.

This study suggests the need for further research of concepts held by prospective teachers including men as well as women. Other areas of possible study are an investigation of the effects of various educational procedures upon the emerging concepts of college students. Additional research of concepts toward developmental tasks of adolescents is indicated by this study in which other developmental tasks are used as a basis and other media employed for eliciting an expression of concepts.

Microfilm \$3.15; Xerox \$11.05. 244 pages.

## JOURNALISM

AN ANALYSIS OF THE SCHOOL CONTENT  
IN MICHIGAN NEWSPAPERS;  
COMPARISONS WITH A SIMILAR STUDY  
AND IMPLICATIONS FOR  
SCHOOL-PRESS RELATIONS.

(L. C. Card No. Mic 60-3420)

William Gregory Monahan, Ed.D.  
Michigan State University, 1960

Major Professor: William H. Roe

This study involved an analysis of the school content in eight daily and fifteen weekly newspapers in the state of Michigan for the period September 1, 1959, through November 30, 1959. The purposes of the study were (1) to determine the quantity and quality of school news in Michigan newspapers from a representative sample and to compare findings with a similar study conducted in 1953-54; (2) to determine implications for improving school-press relations.

The school content was categorized into twenty classifications; front pages were quantified separately as were the number and type of school-related illustrations. Reliability was determined for both measurement and classification of the content. The unit that was used for quantification was the column-inch. (One column wide by one vertical inch.)

For the period of the study, 15,460.5 column-inches of school news were analyzed in weekly newspapers, and

39,467 column-inches of school news were analyzed in daily newspapers. The weekly papers in the sample had a circulation range from 870 for the lowest paper to 10,325 for the highest; among the daily papers in the sample, the circulation range was 3,477 to 59,345. Metropolitan daily newspapers were excluded from the sample. These newspapers provided a total sample of 818 newspapers with a total of 14,382 pages.

Daily newspapers give slightly more than half of all school content space to athletics and athletic illustrations. Weekly newspapers devote a little more than one-third of total school content to athletics. Other high ranking classifications of school content were curriculum items, finance, miscellaneous items (mostly dealing with the opening of school), general illustrations, and student activities. Items accounting for small amounts of space in both daily and weekly newspapers were school operation, transportation, honor roll, adult education, and safety.

When compared to a similar study conducted in 1953-54 and which used the same classification system, the most striking difference is the amount of space devoted to curriculum. In the present study, curriculum accounted for 7.5 percent of all school content; in the previous study, curriculum accounted for less than .1 percent. In both studies, athletics accounted for the most space.

In analyzing the quality of school content, it was found that feature articles about the schools are generally the best quality of newspaper coverage of schools. Editorial comment was relatively rare but generally favorable to the work and operation of the schools. The analysis of



current editorials about the schools led the writer to examine editorial comment in three daily papers in the sample for a three-month period immediately following the launching of the first Russian satellite in 1957. This analysis disclosed that there was little editorial comment about schools in relation to Sputnik. Those educationally-related editorials that did appear in reference to Sputnik were predominantly favorable to the schools.

Some of the more important conclusions of the study may be summarized as follows:

1. Newspapers in Michigan provide adequate information about the schools and persons who have access to newspapers can profitably utilize them to become better informed about the schools.
2. There is an apparent trend toward increased newspaper content dealing with the classroom activities and learning experiences of children as well as greater emphasis on academic matters.
3. Though some newspapers do an outstanding job of feature reporting on many aspects of the schools, a greater number do not take advantage of numerous opportunities for feature articles on a variety of school-related occurrences.
4. American Education Week receives wide and competent coverage by both daily and weekly newspapers.

Microfilm \$2.50; Xerox \$8.20. 177 pages.

THE TREATMENT  
OF THE LITTLE ROCK, ARKANSAS,  
SCHOOL INTEGRATION INCIDENT  
IN THE DAILY PRESS OF THE  
UNION OF SOUTH AFRICA, WEST NIGERIA  
AND GHANA FROM  
SEPTEMBER 1 TO OCTOBER 31, 1957.

(L. C. Card No. Mic 60-3762)

Michael Traber, Ph.D.  
New York University, 1960

Chairman: Professor Charles A. Siepmann

The problem of the study was to identify and analyze the degree and focus of attention given to the Little Rock, Arkansas, school integration incident in the daily press of South Africa, West Nigeria, and Ghana, from September 1, to October 31, 1957. Twenty-five daily newspapers were studied; eighteen from South Africa (four Afrikaans and fourteen English-language papers); four from West Nigeria; and three from Ghana.

'Degree of attention' was measured in four dimensions of analysis: Number of articles devoted to Little Rock; the amount of column space; location of items on either front page or inside page; and number of days on which the incident was covered.

'Focus of attention' or the major themes of the following editorial material were identified: Headlines of news stories on the two days of top coverage; photographs; cartoons; and editorials on Little Rock. Only the editorials

of the two main groups of South African newspapers (Afrikaans and English-language) were analyzed by method of quantification; the rest of the editorial material was analyzed by impressionistic techniques.

The principal findings of the study are as follows:

(1) All twenty-five African newspapers mentioned the Arkansas racial controversy, in spite of the strong orientation to domestic news of many of the papers. On an average, the Little Rock story was covered for 29 days, in the South African press; for 13 days in the West Nigerian newspapers; and for nine days in the Ghanaian press.

(2) There was no significant difference between the degree of attention of the Afrikaans and English-language press of South Africa. However, differences in the types of items and the display prominence did exist between the two groups of newspapers; firstly, the Afrikaans press presented the story with greater emphasis on 'opinion items' (editorials, special column, cartoons), whereas the English-language press stressed news stories; and secondly, the Little Rock incident received a greater front page coverage in the Afrikaans papers than it did in the English papers.

(3) With regard to the focus of attention, the main differences between the Afrikaans and English-language presses were identified as follows: in the Afrikaans press, the Little Rock incident was portrayed as rather typical of the state of race relations of the United States; whereas this same fact was emphatically denied by the English-language press; in the opinion of the Afrikaans press, the alleged causes of the Arkansas conflict were imposed integration and an infringement upon states' rights by the federal government whereas in the English-language press, the responsibility for this conflict was attributed to the person of Governor Faubus; and finally there was in the Afrikaans press, a consistent tendency to relate the Little Rock incident to the Nationalist Party policy, for the support of which the American racial controversy was cited.

(4) In West Nigerian and Ghanaian dailies, the Little Rock incident gained substantially in significance in connection with the segregation incident at Dover, Delaware, involving the Ghanaian Finance Minister.

(5) Race consciousness, viz., counter-racialism was expressed in West Nigerian and Ghanaian newspapers which tended to identify the American Negro with the African both in terminology and concern for the cause of the Negro.

(6) In West Nigerian, Ghanaian, as well as in South African newspapers, if an attack was levelled against the United States, the focal point of emphasis may be said to have been the alleged cleavage between the professed ideals of America and the practice of them, rather than the racial problems of the United States as such.

Microfilm \$4.25; Xerox \$15.10. 331 pages.

THE COMMUNITY PRESS OF SUBURBIA:  
A CASE STUDY  
OF PADDOCK NEWSPAPERS.

(L. C. Card No. Mic 60-4812)

Jerrold Lee Werthimer, Ph.D.  
Northwestern University, 1960

Supervisor: Kenneth E. Olson

This study is not only an analysis of the successful operation of 13 weekly newspapers in Chicago's northwest suburbs, but it also treats an area of community journalism which until now has been neglected. No study of the suburban press has been published since 1928.

The first part of the study is devoted to the national picture--the explosive growth of the suburbs, suburbia as a market, and the essence of the suburban trend. The nature of suburbia is examined in terms of the variety of distinctive social, economic and political patterns in various types of suburbs. The "community consciousness" of suburbanites is examined in terms of the conditions which create suburbs and the impositions of new population types and social classes.

Suburban newspapers are found to have qualities distinctive from urban community newspapers, rural weeklies and metropolitan dailies. The author surveyed 2,000 suburban newspapers and tabulated 571 questionnaires. Publishers and editors were most concerned about the mushroom growth of new communities and keeping up with the problems of suburbanization.

A new journalism is emerging in the metropolitan fringe areas where the birth of new communities provides the marketplace for unique and lucrative newspapers. These newspapers are found to have individuality and influence.

Suburban editors utilize a personalized, grass-roots intimacy with readers and sophisticated journalistic techniques. Suburbia has created an audience demanding "small town" news with an urban flavor.

The suburban press is found to influence the behavior of readers. It operates as an integrating force; it defines the community; it publicizes its activities; it advertises its goods and services, and it serves as a public address system for local leaders.

The case study of Paddock newspapers examines the major changes caused by suburban growth in three types of suburbs, how changes affect the communities, how the newspapers meet the changes, and the impact of this dynamic process.

The settings of the case study represent the typical growth patterns of (1) brand-new tract developments becoming incorporated; (2) small villages becoming urbanized, and (3) established towns becoming ringed by subdivisions, shopping centers, industry and apartment buildings.

The newspapers of Paddock Publications, Inc., changed in five years from country-type weeklies to professionalized products which currently lead all paid-circulation weeklies in the nation in advertising lineage, newsstand sales and number of pages. The papers were selected for their overall editorial quality, particularly in their interpretation of changing suburban problems.

The Paddocks realized that dramatic growth created the need for newspapers which would stimulate interest and maintain consensus in the new and older villages which were attracting large numbers of apathetic commuters and divergent types of social groups. They concentrated on the development of additional newspapers and services to the communities rather than on commercial printing.

The change in policy was directed by a young but well-educated managing editor who saw the opportunity to rejuvenate the marketplace of ideas by giving a voice to the new residents. Depth coverage of local news in spatio-temporal perspective provided newcomers with an understanding of their role as suburbanites.

The Paddocks invested heavily in plant and equipment, but concentrated on hiring a staff of journalism graduates. Aiming toward community service, the news editors expanded local coverage, wrote interpretative features and took strong, controversial editorial positions. The editors received some negative feedback but also measurable impact. The editors' courage and integrity built a favorable image in the minds of readers. Metropolitan dailies represented no threat as long as the community newspapers localized every significant event relevant to suburbia. As a result, the newspapers have prospered and have become agents of community welfare and progress.

Microfilm \$5.05; Xerox \$17.80. 394 pages.



## LANGUAGE AND LITERATURE

### LANGUAGE AND LITERATURE, GENERAL

#### SIR KAY: A STUDY OF THE CHARACTER OF THE SENESCHAL OF KING ARTHUR'S COURT.

(L. C. Card No. Mic 60-3658)

Harold Jerome Herman, Ph.D.  
University of Pennsylvania, 1960

Supervisor: Professor MacEdward Leach

Of all the phases of the study of Sir Kay, perhaps none is more fascinating than tracing the evolution of this Arthurian figure from the time of his first appearance in legend as Kei, the glorified hero of early Welsh literature, to Caius, the noble and valiant dapifer of Arthur's court, in Geoffrey of Monmouth's *Historia Regum Britanniae*, and to Keu, the foolhardy, quarrelsome, bitter-tongued seneschal in the romances of Chrétien de Troyes. The first section of this study is devoted to an examination of the role and character of Kay in the natively-inspired Welsh works, an area which heretofore had been inadequately covered. The traditional Welsh portrayal of Kay is then traced to Geoffrey's *Historia* and subsequent chronicles. This second chapter contains a discussion of Kay's appearance in representative chronicles of the twelfth to the fifteenth century, since previous investigations have been far too general. The third section contains a resumé of those episodes in which Kay appears in the romances of Chrétien de Troyes and the corresponding Welsh prose tales.

The next section of the paper is devoted to a discussion of the so-called *Mabinogionfrage* (the controversy concerning the relationship of Chrétien's poems with the Welsh tales). Special attention is focused on Professor Roger Sherman Loomis' postulation of the existence of four long prose romances in French—now lost—which were based on Breton tales and written not long before the composition of Chrétien's *Erec* and which served as the original sources of Chrétien's poems and the Welsh romances, sources which were treated by Chrétien and the Welsh authors with considerable freedom as to details. Now that the common source theory is generally accepted as the solution of the so-called *Mabinogionfrage*, Chrétien can no longer be considered to be the first writer to portray Kay as the spiteful seneschal of Arthur's court, for a comparison of Chrétien's poems with the corresponding Welsh tales has revealed that the poet of Troyes carried over into his romances the ill-natured Kay of the common source romance. However, Chrétien did alter the character of Kay by emphasizing those characteristics which were antitheses of courtly traits. Kay evidently was regarded by Chrétien as serving a didactic purpose in his treatise of *cortoisie*.

The last chapter concerns the transformation of the character of Sir Kay. The deterioration of the character of the heroic Welsh Kay was a gradual process. His supernatural qualities were dropped or rationalized, and he, like

other Arthurian figures, was demoted in order to exalt the hero of a romance. Eventually Kay was presented simply as one of Arthur's many knights and particularly as Arthur's seneschal. Why was Kay portrayed as an ill-natured person? Perhaps in revenge for the insults suffered and the misery endured at the hands of the seneschal, who was in charge of court entertainers, the Breton *conteurs* portrayed Arthur's seneschal as a despicable person. The character type represented by Conan and Bricriu or the Tristan seneschal (the false claimant of *The Two Brothers*) could have served as models. Another suggestion is that the wandering *conteurs* portrayed Kay as the ill-natured seneschal because in order to subsist they had to appeal to the likes and dislikes of their audiences. Contemporary accounts of seneschals whose abuses of their powers brought ill repute to the name of seneschal indicate that this official was an unpopular figure in medieval times. In fact, the wicked seneschal is a commonplace in medieval literature. Consequently, aware of the odium attached to the name of seneschal, the *conteurs*, seeking to please their audience, ignored the traditional noble character of Kay and bestowed upon Arthur's seneschal numerous unworthy attributes, principally by contrasting Kay with the hero of the tale (and especially the courteous Gawain) who, by placing Kay in a humiliating position, would be applauded by the *conteurs'* audience.

Microfilm \$2.55; Xerox \$9.00. 196 pages.

#### FROM RIDICULE TO RESPECT: THE EMERGENCE OF THE BOURGEOIS HERO IN THE POPULAR LITERATURE OF EARLIER EIGHTEENTH-CENTURY ENGLAND.

(L. C. Card No. Mic 60-4494)

Alexander Duncan MacGibbon, Ph.D.  
University of Kansas, 1960

During the early years of the eighteenth century, the Protestant Dissenters of the commercial middle class in England still thought of themselves as a group set apart from the rest of the nation not only by the official persecution to which they were subjected but also by a view of religion, politics, and business which was peculiarly their own. Through such spokesmen as Daniel Defoe, a tradesman and Dissenter himself, the dissenting tradesmen demanded toleration of their religious beliefs and approval of their social behavior on the ground that they were necessary to trade and therefore to the well-being of Britain.

The purposes of the present study are to describe the typical Protestant Dissenter of the commercial middle class in terms of his peculiar creed and of his code of social and business behavior and to show, by means of literary evidence, how he rose to respectable prominence in English journalism, drama, and prose fiction before 1731.

Chapter I presents the problem. The bourgeois hero of the literature under consideration is shown to exhibit certain characteristics which identify him: He has earned his fortune himself through trade; he is useful, industrious, and opposed to begging, with pride in himself and his class and a firm belief in the "Gospel of Work." He is God-fearing and pursues money from what he believes to be Christian motives. A number of social, intellectual, and political conditions underlying the growing respect for the bourgeois hero are examined. Some of the scholarship on the subject of religious toleration is reviewed briefly.

Chapter II presents, by means of an examination of the pamphlet controversy over certain laws which threatened the freedom and security of the Dissenters, the bases on which the dissenting tradesman demanded religious toleration. The Dissenters contended that tolerance was an economic necessity, that united opposition to Roman Catholicism made tolerance of the Dissenters vitally important, that persecution is unchristian, and that error is no crime.

Chapter III describes the improvement in the treatment accorded to the middle-class Dissenter between the time of Wycherley and the time of Lillo and shows that the reformers of the stage were often as much interested in ending the ridicule of the middle class on the stage as they were in eliminating obscenity.

Chapters IV and V examine the work of Daniel Defoe, spokesman for the dissenting tradesman. Because his pronouncements are likely to be general sentiments, he is perhaps the best source in the literature of the period for information on the creed and code of the bourgeois hero. His pamphlets and miscellaneous works show understanding of middle-class problems. He demands religious tolerance for his class on economic grounds. In his prose fiction, he presents middle-class heroes to a dissenting middle-class audience, to whom he recommends tolerance even for Roman Catholics.

The concluding chapter is a discussion of a representative bourgeois hero, Sir Andrew Freeport. Quotations from the pages of *The Spectator* are used to show Sir Andrew as an idealized type exhibiting the best qualities of his class. The sympathetic portrayal of him by Addison and Steele is briefly appraised for its significance.

Thus this study aims to describe the appearance of the middle-class hero in the years preceding his rise to prominence in that truly bourgeois art form, the English novel.

Microfilm \$3.45; Xerox \$12.15. 268 pages.

**"TRY WHAT REPENTANCE CAN":  
A RE-EVALUATION OF THE ENGLISH MYSTERIES  
AS RELIGIOUS DRAMA.**

(L. C. Card No. Mic 60-3827)

Eleanor Alice Prosser, Ph.D.  
Stanford University, 1960

Critics have generally assumed that the medieval religious drama cannot profitably be analyzed as drama, that dramatic technique worth the studying did not appear until realistic comedy was interpolated. Working from a series of a priori assumptions, they have thus dismissed the mysteries as inevitably crude, didactic, and dull, and have

turned to antiquarian studies. The plays themselves have been all but ignored. The present study suggests that the problem has arisen in modern prejudice and fallacious logic. Our patronizing attitude toward the "naive children" of the Middle Ages has blinded us to the dramatic potential of the mysteries.

The purpose of the dissertation is to re-evaluate the religious drama *qua* religious drama: that is, to accept and understand the religious purpose of the plays and the specific doctrines incorporated; and then imaginatively to view the plays as they were produced for an audience of average intelligence and honest faith.

Such an approach requires knowledge of a complex body of doctrine and attendant traditions if the critic is to evaluate the playwright's purpose and the audience's reaction. Thus it has been necessary to select only one doctrine and limit analysis to those plays in which it is relevant. Chapter II isolates the doctrine of repentance, a doctrine of particular significance for the drama which arose in the Festival of Corpus Christi, and summarizes those tenets with which the medieval audience was familiar.

The body of the dissertation is an intensive, line-by-line examination of plays on five subjects in which repentance doctrine is crucial in the action: the treatments of Cain, Joseph, the Woman Taken in Adultery, Magdalene, and Thomas. Plays on the same subject are compared in terms of such accepted dramatic criteria as unity of effect, plot structure, characterization, etc. A new evaluation becomes inevitable.

The final chapter therefore challenges seven interrelated assumptions which have hardened into critical dogma and argues that they are either invalid, or, at very least, suspect. First, the phenomenal longevity of plays which are earnestly didactic denies that medieval man was bored by dramatized religion. Assuming that the audience responded only to secular interpolations, we have blinded ourselves to the dramatic potential of the religious plays. Second, the traditional stories did not lack the materials of conflict necessary for drama. We have not detected those religious issues which alert playwrights realized in action. Third, the fixed topics did not dictate conventional treatment. We have merely overlooked doctrinal subtleties and religious echoes that produced striking deviations indicative of conscious artistry. Fourth, development of dramatic craftsmanship was not contingent upon the interpolation of comedy. On the contrary, excrement comic elements often marked a deterioration in dramatic structure. Fifth, drama did not improve progressively as the plays became secularized. Inept craftsmanship is characteristic of late and secular revisions, whereas highly skillful techniques are found in many of the "primitive" plays traditionally dismissed. Sixth, and most important, the study emphatically denies that didactic urgency eliminates the possibility of dramatic effectiveness. In all five of the groups of plays analyzed, without exception the best as drama, the most effective, are the best precisely because the religious point is most vivid, because idea and form--doctrine and drama--have been skillfully fused. Seventh, the study thus insists that the religion of medieval man must be a matter of primary concern if we are to evaluate the drama which it infused.

The conclusions urgently suggest that we look at the medieval drama as drama, through the eyes of the medieval audience, rather than viewing the plays as historical phenomena through the distorted lens of traditional assumptions.

Microfilm \$3.65; Xerox \$12.85. 283 pages.



## SHELLEY'S VIEW OF WOMAN

(L. C. Card No. Mic 59-4427)

Catherine Papadopoulou Rose, Ph.D.  
The Claremont Graduate School, 1959

Among the numerous studies about Shelley, I have found none that is exclusively devoted to what Shelley thought about woman. I believe that Shelley's view of and relationship to woman deserves special investigation. My reasons for this are that most of Shelley's poetry is characterized by both the prominence and the importance of women (Cythna, Beatrice, Helen, Emilia, Asia, the Witch of Atlas, etc.), and, moreover, Shelley's personal experiences have been greatly conditioned by his contact with a number of women.

The purpose of this dissertation is chiefly to analyze Shelley's poetry, prose, and letters to see what he thought about woman's capacities, her role in the world, and what kind of woman he desired for humanity and for himself. To make such an analysis meaningful, I have related his works to his life so as to substantiate his theory by his practice.

I have reached the following conclusions:

1. Shelley had very clear and unchanging opinions about woman and love. I have taken pains to emphasize the clarity and consistency of Shelley's views on these two themes, which I believe are especially important in the study of Shelley's poetry and life.
2. Shelley saw woman at least equal (if not superior) to man in intellect, and more precocious.
3. Woman, according to Shelley, need not and should not be servile to man in any way. No one -- and least of all woman herself -- should consider woman inferior to man, or subject to man's will. Shelley explicitly states that man is responsible for woman's servility in the past, a servility of body as well as mind, from which she has not yet fully recovered.
4. Woman is not primarily a female companion to man but an actively useful part of humanity, in the same way that man should be. Such a view of woman, who is seen first in the world at large rather than in the home, is in contrast, of course, with Milton's view of woman, and very different also from that of Shelley's contemporaries, Wordsworth, Byron, and Keats.
5. Woman's femininity, according to Shelley, is important. It resides in her gracefulness of form and expressiveness of features. Weakness and helplessness are not, for Shelley, desired characteristics in woman. Almost always, Shelley couples woman's gentleness with her strength. "Strong yet mild" is his repeated expression describing the women in his major poetry.
6. A comparison of the women in Shelley's poetry with his remarks to or about women in his letters, reveals that Shelley thought women, in general, were somewhat deficient in "virtue" (i.e., as I have shown, selflessness and active benevolence).
7. Lastly, I found that far from envisioning an impossibly Utopian Woman, as a number of his biographers have claimed for Shelley, he saw woman as an emancipated person who did not depend on man for her happiness, but whose intellect and goodness benefited both her and humanity. Shelley's woman may be exceptional, but she is not impossible. Microfilm \$2.70; Xerox \$9.45. 206 pages.

EMILY DICKINSON  
AND THE ORTHODOX TRADITION

(L. C. Card No. Mic 60-4268)

John Stewart Wheatcroft, Ph.D.  
Rutgers University, 1960

Major Professor: Walter E. Bezanson

The poetry of Emily Dickinson is an emanation of the orthodox Protestant tradition in western New England. Dickinson was a native of the Connecticut Valley, which remained orthodox into the nineteenth century. Hooker, Taylor, and Stoddard, three Valley patriarchs, are forebears of Dickinson.

Edwards is the central figure in the Valley tradition. Combining an empirical instinct with a digesting of Newton and Locke, Edwards effected a revolution in Puritan theology and rhetoric. Edwards' dichotomy between the inner and outer worlds is an axial line in Dickinson's poetry. Edwards' notion of conversion, the formation of a "new simple idea," parallels the idea of creating a poem for Dickinson.

Isaac Watts, the most important outside force on later New England orthodoxy, influenced Dickinson's poetry through his Psalms and Hymns. Watts helped shape Dickinson's technical notions of poetry. In the mind of the young Dickinson, the Watts' hymn is the archetype of a poem. Watts' direct effect can be seen in parody, parallel, and echo.

Through the nineteenth century the clergyman was the culture hero of the Valley. Edwards' followers-- Bellamy, Hopkins, Dwight, West-- were such figures. This notion of the clergyman, along with the orthodox theology and rhetoric, descended immediately to Dickinson by way of such Amherst clergymen-teachers as Humphrey, Fiske, Hitchcock, Mary Lyon.

Amherst College, with which the Dickinsons were intimately connected, reflects the orthodoxy in which Emily was bred. Founded by Edwards men, the institution saw its particular mission to be the defense of orthodoxy. In the writings of a representative teacher-clergyman such as Fiske can be found firm links between Edwards and Dickinson.

Amherst Academy and Mount Holyoke Female Seminary were prime shapers of the poet's sensibility. At Amherst Academy, Emily first was compelled to search her heart in orthodox fashion. At Mount Holyoke, Emily passed through the most crucial spiritual experience of her life-- a Lyon revival.

Mary Lyon, a Valley product, carried on a revival tradition that had begun with Stoddard and had culminated in the Great Awakening under Edwards. Later Amherst became a center of Edwardsian revivalism, of which the distinguishing characteristic is severe repression, as contrasted to the emotionalism characteristic of Whitefieldian revivalism.

Emily passed through the Mount Holyoke revival of 1847-1848 without sealing the covenant with the God of her fathers. Inability to participate in this communal rite drove the developing poet from dogmatic to experimental Christianity. The final rejection also effected a feeling of alienation and of failure in the instant of crisis. Revivalism manifests itself in poetic themes and images of hunger and thirst, failure, loss, expectancy, crisis. The repression

characteristic of Edwardsian revivalism is the kind of force that generates Dickinson's poetry.

Mount Holyoke also intensified the clergyman culture-hero image in Emily's mind. In 1855 Emily met Wadsworth in Philadelphia and maintained thin contact with him. Wadsworth, himself a Valley son, represents a decline in the Edwards tradition. But Emily fastened upon Wadsworth as a symbolic lover-deity. Wadsworth's published sermons made him available to her as an idea.

The representative image of white robes illustrates the working of the orthodox tradition in Dickinson's poetry. The image derives from the Bible. Both Edwards and Watts make heavy use of it, so do Lyon, Hitchcock, Fiske, Humphrey. In the aspect of Wadsworth's preaching that appealed to Emily most strongly, eschatology, the white robes image appears consistently.

Dickinson exploits the image of the white robes in many ways. The image allows her to come to terms with death in her imagination. It also provides her with a way of effecting a consummation with the lover-deity whose hold on her is so strong. Finally, it leads her to the realization that to be is to be engaged. Dickinson is a pragmatist writing in a rich cultural tradition.

Microfilm \$5.00; Xerox \$17.55. 390 pages.

#### LANGUAGE AND LITERATURE, CLASSICAL

##### A STUDY OF SLAVERY IN THE LATE ROMAN REPUBLIC FROM THE WORKS OF CICERO

(L. C. Card No. Mic 60-3610)

Arthur Albert Rupprecht, Jr., Ph.D.  
University of Pennsylvania, 1960

Supervisor: Dr. William C. McDermott

An exhaustive study of the references which Cicero makes to the Roman slave system, and to his freedmen and slaves and those of his associates, is pertinent for two reasons. It examines some of the functions of freedmen and slaves in Roman society and it gives further insight into Cicero's personal life.

The first chapter is devoted to the development of the Roman slave system from the Second Punic War until the earliest of Cicero's extant works. Other authors have been cited frequently in order to give a picture of the development of Roman society from the largely agrarian one at the beginning of the period, during which slaves were used for the most part as agricultural workers, until Cicero's time when slaves were trained and used in various capacities; in the trades, the professions and the *familia urbana*, frequently in non-productive capacities.

The remaining chapters are devoted to studies of particular aspects of slavery as they present themselves in Cicero's works. Chapter two is written in answer to Westermann's conclusion that no division can be established between the laws of slavery of the Republic and those of the early centuries of the Empire. Cicero's statements, when compared with the later legal writers

and codes, provide information to show numerous differences in laws dealing with slavery of the two periods. Chapter three concerns the use of freedmen and slaves in armed gangs by Roman politicians, notably Milo and Clodius, in the period preceding the Civil War. Also included are other instances of violence in which freedmen and slaves were involved both at Rome and elsewhere.

In chapters four, five and six all of the references in Cicero's works to his own freedmen and slaves, those of his brother Quintus, his close friend T. Pomponius Atticus and his other friends and clients are considered. The information in these chapters, largely prosopographical, shows the many different ways in which freedmen and slaves served their patrons and masters. It also gives a good indication of how freedmen and slaves lived. Chapter seven concerns some of the terms which Cicero uses to designate freedmen and slaves who performed specialized tasks. The words, *vilicus*, *procurator*, *tabellarius*, *scriba* and *librarius*, are defined according to Ciceronian usage. The terms *procurator* and *scriba* are given special attention because of the meanings that were given to these words in later times.

Chapter eight is a study of Cicero's use of figures of speech based on slavery. All of these figures are metaphors and they are applied without any real consistency. Unscrupulous leaders of state, particularly Antony, are characterized as slaves because they are subject to their own passions rather than to the will of the people. Cicero also likens the Roman people to slaves because they have lost their freedom to such despots, and he compares the control which the mind exercises over the body to the master's authority over his slave. In chapter nine Cicero's attitude toward slavery is studied. He accepted the basic elements of the system, but is to be commended for his humanitarian treatment of his freedmen and slaves. At the end of the dissertation an appendix is included which contains the names of all the freedmen and slaves whom Cicero mentions in his extant works, with the exception of a few frequently mentioned freedmen such as M. Tullius Tiro and M. Pomponius Dionysius, whose biographies are included in chapters four, five and six.

Microfilm \$3.05; Xerox \$10.60. 235 pages.

##### HERODES ATTICUS: WORLD CITIZEN, A.D. 101-177.

(L. C. Card No. Mic 60-4127)

Harry Carraci Rutledge, Ph.D.  
The Ohio State University, 1960

A biographical study of Herodes Atticus illuminates and enhances our understanding of several aspects of life in the second century after Christ. Herodes Atticus is commonly regarded as the most distinguished figure in the rhetorical movement known as the Second Sophistic; but he was also the most lavish private philanthropist in an era of widespread philanthropy and held the significant position of *amicus principis* for the emperors Hadrian, Antoninus Pius, and Marcus Aurelius. The present biography views Herodes as a man whose chief interests reflect the artistic and intellectual temper of the second century, as far as our principal sources for his career can be



interpreted: the *Vitae Sophistarum* of Flavius Philostratus, the anecdotes of Aulus Gellius, the letters of Cornelius Fronto, and the eighty odd inscriptions from the statuary and edifices donated by Herodes in Greece, Asia Minor, and Italy.

The artistic principles of the Second Sophistic emphasized adroit oratorical improvisation on themes taken from the history and literature of fifth- and fourth-century Greece. Herodes was regarded in his own day as the most able extemporaneous orator among the dozens of contemporaries who made a profession of epideictic oratory, and his private academy near Athens was always well attended. The scion of a family whose wealth had become a byword in the late first century A.D., Herodes was an obvious choice for several of the expensive ceremonial offices that Athens, regardless of her economic distress in the second century, continued to maintain. His marriage with a Roman heiress, Appia Annia Regilla, who was related to the Antonine house, brought Herodes to imperial attention and in 143 he attained the consulship at Rome.

But Herodes held his offices at a time when the Mediterranean world was under the firm control of an imperial bureaucracy; thus the ancient offices had become merely titular honors. Unable to obtain a lasting reputation from public office, and recognizing the ephemeral nature of his rhetorical art, Herodes gave his greatest attention and resources to architectural benefactions. Among his gifts were the Odeum for Regilla and the renovated Panathenaic stadium at Athens, the enlarged Fountain of Peirene at Corinth, the renovated stadium at Delphi, and, above all, a grandiose nymphaeum for the Altis at Olympia, which contained a series of statues representing both Herodes' family and the house of the Antonines.

The ensemble at Olympia proclaimed to the world that Herodes was singularly close to the imperial house and, through an almost unexampled combination of prestige and wealth, was the world's foremost private citizen. Herodes could enjoy such an elevated social position only because of the solid unity which the imperial system, especially under Antoninus Pius, had given to the Oecumene. The world has never again experienced such unity that one fortunate man (excepting the imperial family, who naturally were above the normal social denominations) could validly be described as the most eminent citizen of the world.

The study concludes with a summary of the discussions that have taken place in the last half-century over the *Περὶ πολιτείας*, the one extant work attributed to Herodes Atticus. The evidence for such attribution is unsubstantial, although the document could have come from Herodes' atelier. Finally, there is appended an epigraphical index pertaining to Herodes, his wife Regilla, and his son Bradua.

Microfilm \$3.35; Xerox \$11.70. 260 pages.

## LANGUAGE AND LITERATURE, LINGUISTICS

### KORKU PHONOLOGY AND MORPHOPHONEMICS

(L. C. Card No. Mic 60-3712)

Norman Herbert Zide, Ph.D.  
University of Pennsylvania, 1960

Supervisor: Zellig S. Harris

This dissertation presents an analysis of the phonology and morphophonemics of the dialect of Korku spoken in the village of Dahenda near Dharni, Melghat Tahsil, Amravati District, Vidarbha, Bombay State, India. Korku is a Munda language.

Those topics receiving extended treatment in the phonology are low tone-cum-aspiration, and stress. Two phonemic analyses of the former are presented, one of these being preferred for its convenience elsewhere in the grammatical description. A peculiarity of 'low tone' in Korku is its domain: every syllable in a 'phonological phrase' following a low-toned syllable in that phrase is itself low. Thus, in the phonological phrase meaning 'my father's house near the river;' /iŷâ#âbâ#gâdâ+ mērâ#ūrâq=/, all the syllables of the last three words: /-#âbâ#-/, 'father's,' /-#gâdâ+ mērâ#-/ 'near the river's,' and /-#ūrâq=/'house' are necessarily low since they follow /iŷâ#-/, 'my,' which contains a low syllable.

In describing stress, we make use of two undefined terms: 'syllable,' and 'stress.' Every syllable in Korku is heard as either 'stressed' or 'unstressed.' A construct 'strength' (or 'rank') is derived which is used to characterize every syllable type in the language; each syllable type is rated as 'having' some degree of strength from primary, the strongest, to quinary. Syllables are typed on the basis of their consonant-semivowel-vowel composition. A system of rules is given which assigns a stress value to every syllable in the language the basis of its syllable type strength, and its syllable position within its 'phonological work.' There are two values: 'stress' and 'unstressed.' The assigned values correspond to the heard syllable stress for most syllables; syllables wrongly stress-valued belong to phonological words containing one or more 'phonemically stressed' syllables. Phonemic stress is so assigned as to permit the rules to properly stress-value every phonological word in the language. The distribution of phonemic stress permits an optimally simple 'morphophonemics of stress.'

The morphophonemic sections take up stress, tone and 'vowel quality.'

A basic morphological unit (BU) is defined within which restrictions on vowel and aspiration co-occurrence are found. The earlier five vowel morphophonemes and one morphophoneme of low tone can be simply reinterpreted for BU as an eight vowel morphophonemic system with three of its vowels 'inherently low.' The co-occurrence restrictions on these eight vowels are described by 'vowel harmony rules' obtaining among three 'harmonic sets' of vowels: the 'cardinal vowels' //i,a,u//, the inherently low 'central vowels' //I,A,U//, and the 'mid vowels' //e,o//.

Microfilm \$2.50; Xerox \$5.40. 107 pages.

## LANGUAGE AND LITERATURE, MODERN

SHERWOOD ANDERSON  
AND THE MEANING OF  
THE AMERICAN EXPERIENCE

(L. C. Card No. Mic 60-3407)

David Daniel Anderson, Ph.D.  
Michigan State University, 1960

Major Professor: Russel B. Nye

It is the thesis of this study that Sherwood Anderson's works in all their variety of form from short story to essay to novel to autobiographical memoir must be approached as a unit rather than as isolated segments in order to determine what Anderson was trying to do in his writing career, what he was trying to say, and whether or not he was successful. Thus approached, the thesis further contends that the works as a whole provide the record of one man's attempt to understand the relationship between the individual and the time in which he lived and to determine the ultimate meaning of that relationship.

In attempting to establish the validity of this thesis the study takes three factors into consideration. First, the works are examined chronologically in the effort to determine the evolving pattern of Anderson's approach to finding the meaning of the relationship between the individual and his time. Secondly, the study focuses on the works themselves. However, because Anderson's letters and the background of his life shed much light on the specific instances of experience that he was trying to interpret, they are discussed when they aid interpretation. Thirdly, the study includes all of Anderson's works pertinent to the study, including all that appeared in book form and much that appeared in periodicals only.

For purposes of convenience the study divides Anderson's literary career into three major periods: from 1912 to 1918, when Anderson first began to attempt his analysis of the American scene; from 1919 to 1929, when his analysis became close and penetrating; and from 1929 to 1940, when he began to formulate his conclusions.

The first period is discussed in Chapter II, "The Man and the Myth," and Chapter III, "Tentative Analysis." The former deals with the background of Anderson's formative years, an understanding of which is essential to the analysis of a majority of his works, while the latter discusses his first three books, *Windy McPherson's Son*, *Marching Men*, and *Mid-American Chants*, as well as several of the early uncollected essays and short stories.

Anderson's second period is discussed in Chapter IV, "Moments of Insight"; Chapter VI, "The Larger View: Social Analysis and Despair"; and Chapter VI, "Introspection and Identification." The first deals with Anderson's achievement in *Winesburg, Ohio*. The second studies Anderson's attempts at analysis of major social problems in the novels *Poor White* and *Many Marriages* and the volumes of short stories, *The Triumph of the Egg* and *Horses and Men*, in which Anderson came closest to naturalism. The third deals with Anderson's search for permanent values in his own life and his native Midwest, and it records his slow discovery of such values.

Anderson's last period is discussed in four chapters, Chapter VII, "The Townsman"; Chapter VIII, "Re-entry Into the World"; Chapter IX, "The Townsman and the

World"; and Chapter X, "Final Statement." Chapter VII discusses Anderson's attempts to recreate the nineteenth century personal world in his own life as well as in his writing; Chapter VIII looks at the works in which Anderson attempts to bridge the gap between past and present; and Chapter IX records Anderson's attempt to diagnose the ailments of a depression-torn nation and to point out the values that may remedy those ills. Chapter X discusses Anderson's last two works, *Home Town*, in which he evokes the spirit that he feels is permanent in America, and his *Memoirs*, the work in which he records his final appraisal of the meaning inherent in the American experience.

The study concludes with a discussion of Anderson's permanent contributions to American literature and an evaluation of his place as a writer in relationship to the major literary figures of his time.

Microfilm \$5.70; Xerox \$20.30. 448 pages.

DAS DIONYSISCHE  
IN DEN WERKEN WILHELM HEINSES.  
[German Text].

(L. C. Card No. Mic 60-4734)

Max Lorenz Baeumer, Ph.D.  
Northwestern University, 1960

Since Nietzsche the Dionysian has been regarded primarily as either a psychological or an aesthetic-literary phenomenon. Due to its irrationality the Dionysian is not satisfactorily expressed by a short rational formula. A better approach is an analysis of its various psychological-aesthetic forms of appearance. The first two chapters contain an outline of the Dionysian as a literary phenomenon: the myth and the cult of the Greek god Dionysus as well as Schelling's and Nietzsche's conception of the Dionysian. The nature of the Dionysian manifests itself as an intense exaltation of emotion, an ecstasy, or on the other hand a motionless state of bliss and exalted happiness.

Wilhelm Heinse describes the Dionysian state as a feeling of overflowing divine life, caused by superhuman power which seizes the man of genius and urges him in a boundless awareness of power to the greatest deeds and pleasures. The godlike man strives for the highest pleasure and accepts the deepest agony of suffering. The Titanic defiance and tragic heroism culminate in the ecstatic experience of the Dionysian death as supreme sacrifice. For Heinse, the feeling of being godlike reveals itself above all in the ideal of the 'Megalopsychos', the man of great soul, who corresponds to Nietzsche's Superman and his Zarathustra.

The exalted "Lebensgefühl", originating in energy and the sense of beauty, is the second form in which the Dionysian appears. Life in the works of Heinse is deeply rooted in the eternal nature. Thus the Dionysiac feels that he is united with this nature and with the divine universe. The mystery of life and death is experienced in creation and destruction, and the great artist creates such life when he is in the state of highest enthusiasm.

The Dionysian pleasure differs from hedonism by including all types of pleasures and raising them in superabundance and excess to the frenzied experience of madness



and extermination. The highest degree of pleasure exists for Ardinghello either in the raging frenzy of love, ardent friendship, and fighting, or in quiet heavenly happiness and bliss as in a state of delightful self-dissolution.

Erotic pleasure and sexual love are enhanced in Heinse's works by their ultimate goal: begetting and creating. The human being participates in the eternal and joyful creation of new life in nature and the universe while experiencing the pleasure of begetting and bearing a child.

Heinse claims ethical independence for the great artistic man and justifies this with the boundless exaltation and lack of restraint of Dionysian pleasure. Such a Dionysian evaluation of existence in the works of Heinse is the reason for his "aesthetic amorality." Heinse is opposed to the church, religion, Kant's philosophy, and the morality of his contemporary society. The Dionysiac always lives in protest against the morale of the vulgar crowd. Greek antiquity and the Renaissance are to him ideal settings for men of the Ardinghello type.

Finally, the phenomenon of the Utopia, of the imaginary land of eternal pleasure, is basic to the conception of the Dionysian. Utopia expresses the longing for the Dionysian state of perpetual bliss and exalted happiness. Heinse's Utopia, like the paradise of classical antiquity and that of Nietzsche, was located among the islands of Greece. Here he finds the prototype of his rapturous life and pleasure of art, and also the visionary ideal of regeneration of his Dionysian Greece.

The aesthetics of Heinse, as it emerges in his enthusiastic lyric language and in the impressionistic sensual descriptions of nature and works of art, is plainly expressed in his Dionysian conception of art. This is glorified in his diaries and in 'Ardinghello', and contrasts with the Apollinian perceptions of Mengs and Winckelmann.

Heinse agrees with Nietzsche not only in his interpretation of the Renaissance, but also in principles and details concerning the conception of the Dionysian. Both try to compensate for their inferiority complexes with Dionysian visions. Both take the same position of Dionysian protest against the bourgeois society and proclaim the amoral superman. Microfilm \$2.50; Xerox \$9.00. 198 pages.

THE "CONTEMPORANEOS," 1915-1932:  
A STUDY IN  
TWENTIETH-CENTURY MEXICAN LETTERS.

(L. C. Card No. Mic 60-3917)

Merlin Henry Forster, Ph.D.  
University of Illinois, 1960

The purpose of this study was to describe the small but controversial group of Mexican writers known as the "Contemporáneos," to document their association during the years 1915-1932, and to evaluate their literary contribution during those years.

The "Contemporáneos" were first placed within the larger frame of recent Mexican literature: subsequent to and influenced by the "Ateneo de México," and concurrent with estridentismo and the well-known "novel of the Revolution."

Based on the criteria of comparable age, common educational background, and significant participation in group

projects, three sub-groups were distinguished: 1) Jaime Torres Bodet, Bernardo Ortiz de Montellano, José Gorostiza, and Enrique González Rojo, who knew each other as students and were the nucleus of the larger group; 2) Xavier Villaurrutia and Salvador Novo; 3) Jorge Cuesta and Gilberto Owen. These young writers, until their dispersion shortly before 1932, were associated in a loosely-knit group (in Torres Bodet's phrase, "un grupo de soledades") which comprehended both common effort and strong individuality.

Group association and development were found to be closely linked to a series of patronage jobs within government agencies, and group expression was made possible in a succession of literary reviews and an anthology-manifesto: *La Falange* (1922-23), edited by Torres Bodet and Ortiz de Montellano; *Ulises* (1927-28), edited by Villaurrutia and Novo; *Antología de la poesía mexicana moderna* (México, 1928), edited by Cuesta with the collaboration of the other group members; *Contemporáneos* (1928-31), directed principally by Ortiz de Montellano; and *Examen* (1932), edited by Cuesta. There was much adverse criticism of some of the reviews and of the anthology, and this criticism may have accelerated the disbanding of the group.

The literary contribution of the "Contemporáneos" from 1920 through 1932 was important, and defined an aesthetic position contrasting with certain concurrent literary movements in Mexico. This position was characterized by literary refinement and sensitivity, the striving for universality in preference to nationalism, and an awareness of the new literary currents in Europe and North America.

The group's outstanding contribution came in poetry. Influenced in their early work by González Martínez and López Velarde, the "Contemporáneos" were also affected after 1925 by the trends in French poetry. In the Mallarmé-Valéry tradition, Gorostiza wrote balanced compositions in traditional meter on the themes of solitude and duality, Villaurrutia began his complex meditations on death in characteristic nocturnos, and Cuesta wrote equation-like sonnets on time, life and death, and solitude. Reflecting Dadaism and Surrealism, Torres Bodet expressed feelings of separation and a continuing search for poetry in unusual imagery and free verse, Ortiz de Montellano portrayed the relationship of the dream world to "reality," and Owen began a characteristic interweaving of theme, imagery, and allusion.

Several of the group (Torres Bodet, Villaurrutia, Novo, and Owen) wrote fictional prose in which they experimented in narrative techniques (e.g., Torres Bodet's "flash-back" and Novo's "stream of consciousness"), emphasized duality, multiplicity, or opposition in the representation of character, and applied techniques seen in their poetry to prose style.

The contribution of members of the group to literary criticism was second only to their contribution as poets. Their essays indicated an awareness of the latest trends in European and American literature, and many of those on contemporary Mexican literature explained and defended the group's stand on aestheticism and universality.

The conclusion drawn from this study is that in spite of unpopularity and early dispersment, the "Contemporáneos"--in both group and individual effort--wrote an important chapter in Mexican literature of the twentieth century, and left a tradition for later groups seen in poets such as Paz and Chumacero.

Microfilm \$2.95; Xerox \$10.15. 225 pages.

A PRELIMINARY STUDY OF  
THE LIBER FORTUNAE,  
A FOURTEENTH-CENTURY FRENCH POEM.

(L. C. Card No. Mic 60-3654)

John Lambert Grigsby, Jr., Ph.D.  
University of Pennsylvania, 1960

Supervisor: William Roach

This dissertation is a preliminary study in the sense that it is essentially an introduction to a critical edition. The text of the *Liber fortunae* exists in two complete manuscripts (MS. French 16 of the University of Pennsylvania Library, Philadelphia, and MS. fr. 12460 of the Bibliothèque Nationale, Paris) and one fragment (MS. 356 of the Bibliothèque Municipale, Clermont-Ferrand). All three manuscripts date from the middle of the fifteenth century, but the poem itself was composed in 1345. Since the period between 1345 and ca. 1450 was one of great linguistic change the extant manuscripts often give the impression that the author made mistakes in versification, especially in meter. To preserve the evidence of the manuscripts and, at the same time, to show that the author did not err in his versification, a critical apparatus was established whereby a reader could easily see how the scribes deviated from the original text. The dissertation includes a specimen text of the first five hundred lines of the poem in order to demonstrate the critical apparatus. The poem as it appears in the Philadelphia manuscript corrected by the other two manuscripts is 4771 lines in length; octosyllabic rhymed couplets occur throughout except where the author occasionally inserted Latin proverbs or sayings. It relates a dream in which the allegorized figure of Fortune appears to the poet, who has been unjustly imprisoned. (A complete summary of the contents may be found in my article, "A New Manuscript of the French *Liber fortunae*," *Romania*, LXXX [1959], 447-460.) Although the author left an enigma of his name in the closing lines of the poem, the enigma is apparently unsolvable. He did state, however, that he was a priest and, according to the results of my study of his language, he was probably from a region east or northeast of Paris. The poem is analogous to the *Roman de la rose* and to Boethius' *Consolatio philosophiae* by its setting, but is closer by its content to the *Somme le roi*, the *Miroir du monde*, the *Manuel des péchés*, and the *Poème moral*. The author may have translated and put into verse certain Latin religious didactic works in his possession. He specifically mentions the *Elucidarius*, for example, as one of his sources. His simple, repetitive style indicates that he wrote the poem in order to teach, rather than to amuse.

Microfilm \$2.50; Xerox \$8.00. 171 pages.

HUGO VON HOFMANNSTHAL:  
EINE STUDIE ZUR  
DICHTERISCHEN SCHAFFENSWEISE.  
[German Text].

(L. C. Card No. Mic 60-4058)

Kurt Herbert Guddat, Ph.D.  
The Ohio State University, 1959

Modern German literature contains no other writer of Hofmannsthal's prominence whose life remained so little known to his readers for so long a time. Hofmannsthal did not seek an Eckermann. His biography is still unwritten. With personal modesty he waited for the ultimate test: the durability of his work in the history of literature.

During recent years, however, the publication of several volumes of his correspondence, some notes and worksheets, and a multitude of reminiscences of his acquaintances has shed light on Hofmannsthal, the artist and man. Compiled and emendated, this material tells of his life from the seventeenth year (1890) until his death (1929). It relates the genesis of most of the larger works. It also communicates the creative joy and anguish previously known only to his most intimate friends.

Based on this material, the study attempts an analysis of Hofmannsthal's creative process. His creativeness is greatly dependent upon the natural environment. For example, unfavorable climatic conditions cast him into the abyss of unproductivity; propitious ones elevate him to the heights of inspiration. The strong dependency upon natural phenomena is manifested in both a seasonal and a diurnal periodicity, the former being so pronounced that it appears to be unparalleled in the creative process of other writers. Less important than weather and season, but still of considerable moment, is the work location. The absence of any tecto-psychic dependency obliterates the extant image of the aesthete creating in luxurious surroundings. Great significance, on the contrary, is attributed by Hofmannsthal to certain elements of nature. They constitute the natural topography of both his native province and the locations he chooses when he is working away from home. The rich metaphorical system of nature in Hofmannsthal's discussion of his inspiration is based on an awareness of geo-psychic forces.

Although there appears to be no change in the elements of nature which affect the creative process throughout the author's life, the influence exerted by the human element varies greatly in different periods. With advancing years Hofmannsthal depends more and more upon the communication with his friends. The study elucidates the human relationships which are decisive for Hofmannsthal's work. An attempt is made to show the ever-present struggle for a harmonious balance of the artist's need for solitude in which to concentrate on the one hand, and his desire for socio-psychic stimulation and for living the life of a son, husband, and father on the other hand. Of particular interest are the references to the atmosphere of the cities which Hofmannsthal visits in his search for inspiration and to the intellectual climate of the era.

The study also discusses some of the inner aspects of the creative process as revealed by Hofmannsthal's statements about the first inspiration, the first draft, the execution, and the revisions of individual works. The analysis of a worksheet reproduced in facsimile points out the danger of drawing conclusions about the creative process



from the finished product, which method was used recently in studies of Hofmannsthal's contemporary, Rilke.

The dissertation finally examines the figures of the writer, the composer, and the artist in Hofmannsthal's works, with their modes of creating. The author appears to have projected himself into these characters only in the figure of the poet in some of the earlier works. It is interesting to observe, however, how Hofmannsthal uses the figure of the composer or the artist either as a mouthpiece of his thought or as a symbol in which the theme of the play is anchored and mirrored.

Microfilm \$4.90; Xerox \$17.35. 383 pages.

#### THE POETRY OF ANDRES ELOY BLANCO

(L. C. Card No. Mic 60-3965)

Unetta Thompson Moore, Ph.D.  
University of Illinois, 1960

The purpose of this study was twofold. The primary goal was the determination of the salient features of the poetry of Andrés Eloy Blanco in the six major collections published during his lifetime, and the secondary, the testing of the efficacy of a quantitative approach in examining selected features of his poetry.

The quantitative method proved useful in studying such aspects as sound patterns, diction and literary techniques relating sound to meaning, but for features such as figurative language, theme, and theses a more intuitive method proved more suitable.

It was found that Blanco's poetry can be divided into three general periods. The first period (*Terras que me oyeron*, *Poda*, *Saldo de poemas 1923-1928*) may be termed his Modernist period, because of its meter, strophic forms, and subject. The second period (*Barco de Piedra*, *Baedeker 2.000*, *Malvina recobrada*) contains Post-Modernist poetry, characterized by free and semi-free verse and certain Vanguardist trends, notably Surrealism and Futurism. The third stage (*Giraluna*) may be identified with that tendency of Post-Modernism characterized by a return to classical and traditional strophes and meters. It is more accurate, however, to avoid identifying Blanco with a single period style and to consider him a modern poet who has adapted only those aspects of recent literary movements which best suit his own personal manner.

In an over-all view of Blanco's poetry, the reader can note definite artistic development and intellectual maturation. One sees a gradual rejection of traditional or time-worn associations and identifications, replaced by new and original ones. One example is the disappearance of references to classical mythology and ancient history and the appearance of references to and elements from modern and contemporary civilization. There are also certain characteristics found throughout his poetry: a broad and varied vocabulary, including the figurative utilization of nautical terms; an abundance of imagery appealing to all the senses; the constant presence of and dependence on the metaphor; the use of sound quality and rhythmic movement to underscore the meaning and enhance the image of a passage; a great interest in man and in themes closely related to man's life and happiness. In several volumes, notably *Barco*, *Baedeker*, and *Malvina*, Blanco has created

fairly complete poetic worlds, one of which is closely connected with reality, and the other two of which are in part fantasy, in part projections into the future.

At times Blanco is a cosmopolitan poet, at others, a regional, an American poet. On some occasions he writes of the city, but more often his setting is the country, frequently the sea or a river. He is not exactly a poet of nature or landscape "painter," however. Rather than describe a countryside directly, Blanco is more inclined to present certain impressions or details selected to produce a particular impression of this landscape. He is essentially a poet of man, man seen as living in or related to nature. Deeply humanitarian, Blanco's major interest lies in man and in hopes for man's future, in all things concerning mankind.

In Blanco's poetry sound and meaning closely complement each other. His better compositions are well organized, their themes and theses logically and artistically developed and there is fresh, original imagery. For the reader interested in content his work offers a wide range of important themes, often with a simple, yet profound message and a belief in the perfectability of man.

Microfilm \$4.55; Xerox \$16.20. 356 pages.

#### A STUDY OF FAULKNER'S PRESENTATION OF SOME PROBLEMS THAT RELATE TO NEGROES

(L. C. Card No. Mic 60-3118)

Agnes Louise Moreland, Ph.D.  
Columbia University, 1960

Although Faulkner has often shown Negro characters to be the source of problems in his fictional world, he has also shown Southern white characters and the total Southern social structure as the primary causes of the trouble-maker role of Negroes. Because of crimes that white men have committed against them, Southern Negroes have been a source of problems since the days of slavery. This four-chapter study is an analysis of some specific problems that relate to Negroes.

Chapter One is a discussion of the origins in slavery of some economic, social, and moral problems that derive from the white-Negro conflict. Those early situations fostered self-destroying ideas among white men about the labor that they might perform with dignity. The slaves developed ideas of caste among themselves and were scornful of "poor white trash"; these latter developed hatred for both slaves and slaveholders. White-Negro interbreeding began during the slavery era when masters made sexual alliances with their slave women. Also a legacy from slavery is the hatred that some Southern white men have for Negroes as the cause of the Civil War and hatred of Northern whites as hypocrites who exploited both Southern white men and Negroes. For the Indians who held slaves, Negroes were also a problem. In depicting slavery-era relations between Negroes and white men, Faulkner has not shown scenes of physical violence toward Negroes. His white and Negro children are loyal friends in spite of their different castes. Faulkner's main concern, therefore, is with the psychological and emotional effects of slavery on the white masters and their descendants.

Chapter Two is a study of miscegenation as a major problem for the white men who fear racial mixing and for the men who have in their veins both "white blood" and "black blood." Many Southern white men define being as being white. Racial mixing that would occur when a Negro male impregnates a Caucasian female would negate being and must therefore be prevented. Children by white fathers and Negro mothers do not threaten the being of the white group. In their attempts to define themselves despite race, Joe Christmas in *Light in August* and Etienne de Saint Velery Bon in *Absalom, Absalom!*--both of whom look like white men--lead tragic lives in defiance of society. Charles Bon's "black blood" precludes recognition from his white father and ordains his murder by his white brother. Lucas Beauchamp in *Intruder in the Dust*, who looks like a Negro, is able to rise above the conflict of "bloods." Faulkner suggests that racial conflict will end with amalgamation of the black and white races.

Chapter Three considers problems that arise in Southern society when a Negro refuses to be subservient to white men. For many white men such defiance of tradition is a threat to order; for the self-assertive Negro such defiance invites violence or death.

Various social problems, including the perversion of law when it deals with Negroes, are the subject of the last chapter of this study. Some of Faulkner's white characters are fanatical in their response to Negroes. Others are insensitive to the emotions of Negroes, which callousness intensifies racial conflict. The Southern Negro prostitute suffers exploitation greater than that ordinarily associated with the profession. However, Faulkner portrays Negro prostitutes and other Negro offenders against the law as victims of an unjust society and, therefore, not so guilty as white law breakers.

Notes toward further study suggest that Faulkner students investigate the writer's statements about Negro "endurance" and also the probability of Faulkner's Southern white men helping to lessen the race conflict.

Microfilm \$3.25; Xerox \$11.25, 250 pages.

#### THE THEME OF MAN'S RESTORATION IN MILTON'S LATER POETRY

(L. C. Card No. Mic 60-3820)

George McMurtry Muldrow, Ph.D.  
Stanford University, 1960

This dissertation examines the theme of man's restoration to God's grace in *Paradise Lost*, *Paradise Regained*, and *Samson Agonistes*. The study is a part of the scholarly trend to relate Milton's thought to his Christian beliefs, and it uses his *Christian Doctrine* as a gloss upon these poems. Special attention is given to the doctrine of regeneration with its signs of repentance and of faith and its effect of Christian liberty.

Milton's doctrine of restoration gives new insight in an interpretation of these poems. In the last three books of *Paradise Lost*, Michael repeats the scheme of salvation presented in the *Christian Doctrine*, and Adam dramatically acts out five steps of repentance to arrive at a renewal of faith. The first three steps (conviction of sin, contrition, and confession) occur in Book X. In Book XI

Michael selects episodes of history to impress upon Adam the consequences of the Fall, until Adam takes a fourth step (rejection of evil) in the Nimrod episode. After that, Michael stresses the Covenant of Grace, the new means by which man may regain true liberty. Adam is converted to good (the fifth step), and the epic closes with his acknowledgment of the Redeemer and his pledge to obey God's will as highest wisdom. The last three books clearly define Adam as the hero and his reconciliation with God as the heroic action of the epic.

*Paradise Regained* is a sequel to *Paradise Lost* in that it shows Christ, man's exemplar, in perfect obedience to the will of God and persevering in faith amid temptation. Although the poem looks forward to Christ's satisfaction of divine justice for all men, the temptation in the wilderness illustrates for the believer the virtues necessary for a preservation of faith. Book II of the *Christian Doctrine* discusses these virtues under the worship of God through good works. Examples of degrees of trust on the first and third days surround the long temptation of the second day, the virtues of which Milton takes from his chapters on man's duties to himself. The climax of the poem is Christ's explanation of wisdom in terms of that liberty of conscience which Milton calls Christian liberty.

Milton's Samson is an exemplar of faith as well as a Hebrew champion. Like Adam, the fallen Samson progresses through the stages of repentance in his regeneration. Realizing his spiritual death, a contrite Samson expresses conviction of his sin in the first episode; the Manoa episode contains his full confession of the sin of disobedience. In the scene with Dalila, Samson rejects evil, explaining that he will not again enslave his soul in her power. His challenge to combat with Harapha contains his renewed faith in God's mercy and thus prepares him for the catastrophe. Samson goes to his tragic death a willing servant of God.

These interpretations suggest several conclusions regarding Milton's later poetry. First, each contains an internal drama of the soul, with obedience and faith as important features; each stresses the need for individual regeneration as the basis for an improved society. Second, the pattern for this individual regeneration is that outlined in the *Christian Doctrine*. *Paradise Lost* and *Samson Agonistes* are the dramatic struggle for fallen man to regain God's favor, while *Paradise Regained* depicts the struggle to maintain divine favor during the temptations of earthly life. Third, the theme of man's restoration establishes more firmly a unity among the three poems and shows Milton's emphasis of an important theological doctrine necessary to complete his justification of God's ways to men. Microfilm \$5.00; Xerox \$17.80. 391 pages.



ROBERT BISHOP'S COMMONPLACE BOOK:  
AN EDITION OF  
A SEVENTEENTH-CENTURY MISCELLANY.

(L. C. Card No. Mic 60-3608)

David Coleman Redding, Ph.D.  
University of Pennsylvania, 1960

Supervisor: M. A. Shaaber

The manuscript transcribed here is in the possession of the Rosenbach Foundation Museum, number 187 in the catalogue *English Poetry to 1700* published by the Rosenbach Company in 1941, and formerly Philipps number 9549. It is a quarto of 306 pages, entitled "Miscellanies/ Or/ A Collection of Diuers witty and/ pleasant Epigrams, Adages, poems/ Epitaphes &c: for the recreation of ye ouertravel-/ ed Sences." The title page bears the date "1630" and the name "Robert Bishop." Although there is no way of identifying positively the compiler, the only likely Robert Bishop is the one who was a student at the Middle Temple in 1614 and who commenced B.A. from Exeter College, Oxford, in 1616. The many poems and epigrams on lawyers and on the people and events of Oxford in the early seventeenth century bear out the identification of the compiler. The evidence supporting 1630 as the date of the manuscript is primarily negative: none of the poems seems to have been written after that date, and the latest date which can be assigned positively is 1627, the date of a group of poems on the proctors' plot at Oxford in that year.

This edition presents the text of MS. Rosenbach 187 along with explanatory notes on the poems and collations of other versions of the texts. I list all other versions known to me; the lists, although they are not complete, give a good idea of the relative contemporary popularity of the poems. Eighteen of the 396 poems in this collection exist in twenty or more contemporary versions, printed and manuscript. These eighteen poems vary in length from 508 lines to four lines, and they represent almost every type of poetry current in the early seventeenth century. The emphasis of the collection as a whole, however, is upon "wit," the appeal to the intellect that a generation before had been most often satisfied by sententiousness. One third of the poems are epigrams (130) and almost one fourth are epitaphs (83), most of them epigrammatic; many of the epigrams and other poems, and even some of the epitaphs, are ribald, and some are simply obscene.

Although many of the poems are anonymous, and I have found no other version at all of seventy-nine of them, I have been able to identify the work of the following poets (the numbers in parentheses represent the number of poems, including fragments, that I have assigned to them): Donne (18), Harington (15), Jonson (10), Corbett (7), Pembroke (5), Bastard (4), Shakespeare (4), Simpson (4), Ayton (3), Parrot (3), Poole (3), Raleigh (3), Stone (3), Strode (3), Sylvester (3), Beaumont (2), Carew (2), Chapman (2), Davies of Hereford (2), Guilpin (2), Lord Herbert (2), Herrick (2), Hoskins (2), and Bacon, Breton, Browne, Campion, Sir John Davies, Dyer, Frankland, Goodwyn, Heywood, Holiday, Juxon, James I, Lapworth, Meredith, Munday, Peacham, Roe, Rowlands, Rudyerd, Sidney, Taylor, Warmestry, and Weever, one each.

Commonplace books, although the texts they contain are

often corrupt, sometimes provide more authentic texts (closer to the poet's own) than do printed versions of a poet's work, particularly if publication came after the poet's death and the printer's manuscript was not the poet's own. Commonplace books, this one among them, also contain poems not apparently preserved in other versions, and, although their ascriptions of authorship are not always reliable, they are important in establishing the canon of a poet's work. In most ways (excepting the great emphasis on derisive wit and the fact that its early part is arranged systematically, as if with an eye to publication), this manuscript is a typical early seventeenth-century miscellany.

Microfilm \$10.95; Xerox \$39.10. 868 pages.

RECURRENT THEMATIC MATERIAL  
AND ITS STRUCTURAL USE  
IN THE WORKS OF MARCEL PROUST

(L. C. Card No. Mic 60-3986)

Raymond Theodore Riva, Ph.D.  
University of Illinois, 1960

This study traces and follows the recurrent themes in Proust's works. Most of these themes fall into one of several groups, which are called clusters, while certain others, which are called major themes, seem to stand apart from the rest. The most important theme of each of the interrelating groups or clusters serves as its title. This subordination of several themes to one major theme in a cluster allows a clearer vision of the major theme, and its function as a nucleus around which the other, less important themes seem to revolve.

Three themes play roles of extraordinary richness in Proust's works. Time, the first, may be said to be the most important theme of Proust's mature work, *A la recherche du temps perdu*. Without it the novel would resemble *Jean Santeuil*, rather than being the innovation in fictional technique that it is. Memory, involuntary memory of course, the next, stands as the means of regaining a lost past. Lost through a passage of Time, the past is retained (in our unconscious mind) by Memory: we have only to discover the secret of regaining this 'lost' past. Proust shows the narrator Marcel in his quest for 'lost' time, and compels the reader himself to discover with Marcel the secret of regaining the past. Multiplicity of the Ego, the third theme, is Proust's concept of man's constant change as he moves through time. Through a very tangible, highly detailed demonstration of the myriad changes occurring within an even short period of time in an individual, Proust fulfills a major aim: he emphasizes the passage of Time within the novel.

These same three themes are notable for their technical functions. Time and Memory are not only themes, they are also structural elements of the novel, integral to the author's perception of all themes. And Multiplicity of the Ego serves the triple function of theme, philosophical concept, and novelistic method which dramatizes for the reader the passage of Time.

The remaining themes, although important, do not have a structural function in the works. Will-power plays quite an important role in Proust's major novel, for at its conclusion we--having just read the novel in question--realize

that the narrator has indeed had sufficient volition to write a novel, his protestations notwithstanding. The corrosive effects of Jealousy upon Love, well-known to all readers of Proust, are treated at length. Jealousy, as we have come to associate it with Proust (that is, all consuming and destructive of love), is essentially a product of his later literary years, for in the early works it is not only less important, but also less well motivated, less believable. The world of Snobs and Snobbery in Proust's works also evolved, as he himself came to know and satirize the world of aristocratic society to which he had so long aspired.

Those themes which do not form a cluster, or which are of insufficient importance to be treated as major themes are discussed as Miscellaneous Themes. These include the Telephone, Sleep and Dreams, Names, Churches and Steeples, and the Dreyfus Affair. Any interrelations between clusters of themes not mentioned previously in the discussion of the clusters themselves are briefly considered in the conclusion.

Microfilm \$2.80; Xerox \$9.70. 214 pages.

#### STUDIES ON THE SAYAGÜES IN THE EARLY SPANISH DRAMA

(L. C. Card No. Mic 60-3613)

Charlotte Daniels Stern, Ph.D.  
University of Pennsylvania, 1960

Supervisors: Joseph E. Gillet and  
Edwin B. Williams

This dissertation is an analysis of the stage jargon called Sayagués, which was the linguistic medium for the Spanish rustic in the early drama. In the study, there is an attempt to justify the designation of Sayagués for the stage dialect. The term was used in the sixteenth and seventeenth centuries as a derogatory epithet which conjured up a vivid image of the rustic. Its application to the stage dialect suggested to the Spaniards of the period a plebeian and barbarous language, which was indeed the yokel's style of expression. At its inception, the stage jargon was not a substandard form of Castilian, but in reality represented a literary version of the Eastern Leonese dialect as spoken in Salamanca. It lacked, however, certain phonetic features of the Western Leonese dialect of Sayago, located in the province of Zamora. Although the Sayagués was a literary jargon which became highly conventionalized in the Spanish *comedia*, it, nevertheless, contains valuable material for investigations in the fields of Spanish dialectology and lexicography.

There is an attempt to reconcile two divergent and seemingly contradictory judgments of previous investigators concerning the nature of the Sayagués: its linguistic accuracy as opposed to its artificial and conventional qualities. In a study of diphthongization, alterations in vowel sounds, use of aspirate *h*, palatalization of initial *l* and *n*, and the change consonant + *l* > consonant + *r*, the jargon definitely reveals its affinity with the Leonese dialect. However, the manipulation of dialectal pronunciations for the convenience of prosody, the difficulties which the poets encountered in the transcription of regional sounds, and the

tendency toward the exaggeration of certain pronunciations for comic effect impair its linguistic value.

In an analysis of the use of the prefixes *es-*, *de-*, *des-*, *per-*, and *re-*, the preponderance of formations with *es-*, the use of an intensive *des-*, and the Sayagués fondness for compounds with *per-* further corroborate the Leonese base for the jargon.

In the Sayagués lexicon, purely arbitrary forms are distinguished from words whose authenticity is implied by their appearance in other sixteenth century texts, in Judeo-Spanish, in Latin American speech, and in contemporary dialects of rural areas of Spain and Portugal. It appears that the arbitrary formations are fewer than previous critics and editors were inclined to believe, and that the great majority of formations used by the early playwrights are perfectly legitimate.

During the sixteenth and seventeenth centuries, there were some fundamental changes in the nature of the Sayagués. These include the eventual disappearance of peculiarly Leonese characteristics, the introduction into the jargon of Castilian vulgarisms as well as regionalisms from other areas of Spain particularly Aragon and Andalusia, the creation of telescope words and amusing distortions of learned words, and the deliberate confusion of phonetically similar but semantically unrelated words.

Finally the stylistic function of the Sayagués in the comic characterization of the rustic is considered. The jargon is viewed as a projection into speech of the yokel's primitive, child-like and emotional nature. The archaic pronunciations and lexicon emphasize his conservatism and his adherence to the past; the *muletillas* reveal his linguistic ineptness, while the polysyllabic compounds created through the accumulation of intensive particles show his inordinate fondness for bombastic-sounding words and his highly subjective attitude toward life. Consequently, in its vocabulary, its phonology and its patterns of word derivation, the Sayagués proved a highly effective medium of communication for a new stock character on the Spanish stage.

Microfilm \$5.15; Xerox \$18.25. 404 pages.

#### A CRITICAL STUDY OF RUTH SUCKOW'S FICTION

(L. C. Card No. Mic 60-4001)

Margaret O'Brien Stewart, Ph.D.  
University of Illinois, 1960

Ruth Suckow (1892-1960) was among the first short story writers and novelists of Iowa to write realistically and authentically about her native state. This study is an analysis of Miss Suckow's fiction, utilizing, in addition to her creative work, her autobiographical statements and her published comments on her literary method and intention. It examines the author's portrayal of her Iowa scene; the social history recorded in her fiction; her interpretation of character; and the narrative method in her novels and short stories. The autobiographical significance of scenes, incidents, and characters is noted, although the study is not biographical. The analysis indicates some of the enduring qualities that give her fiction significance and suggests restrictions in her choice of subject and theme.

To her treatment of the Iowa scene Miss Suckow brings



knowledge, talent, honesty, and compassion. Her eye for visual detail imparts a convincing reality created by faithfulness to minutiae. By limiting her scene to the farmlands and towns she knew intimately, she is able to enter more deeply into the life of the small community. Within a rural setting, imbued with the atmosphere of the folk spirit, Miss Suckow exhibits her gallery of Iowa portraits and family groups, both native born and immigrant.

Her novels depicting the domestic pattern of rural life in the early twentieth century not only mirror the Iowa life but seem partially true for other parts of the country. In portraying a changing period of national history, Miss Suckow emphasizes the themes of social transition and the assimilation of contrasting cultures.

Within the portrayals of family groups she presents in detail the emotions and experiences of childhood, the uncertainties and bewilderments of adolescence, the complacency of an older generation, and the pathos and loneliness of the aged among whom are most of her immigrant characters.

Her purpose to capture and hold a reflection of life is achieved through a pictorial rather than a dramatic presentation. Her characteristic narrative action lacks conflict, crisis, and the resulting intensity of emotion. Her novels hold interest as social history. Her narrative technique is more effective in her short stories than it is in the novels. In the stories her tenderness and compassion attain their consummate expression.

The deeply felt emotions which recur most frequently in her characters are loneliness and isolation, nostalgic yearnings, and the sadness that comes with the realization of lost security. Although she does on occasion show the narrowing effect of the rural pattern and the inadequacy of the older generation's simplified solution to emotional problems, Miss Suckow usually finds a period of confidence and stability most appealing. The repetition of the scene and era of her own youth and the reluctance to relinquish the values of the past impart to her writing, when viewed as a whole, a nostalgic tone. In some of her stories she depicts the drabness and futility of rural life, but in most of them there is an affirmation of rural values. The most distinctive departure from her earlier fiction to be noted in the later novels and stories is an increased affirmative emphasis. The novel, *New Hope* (1942), is the clearest expression of her idealism. In it she portrayed a quasi-utopian society with the enduring values of communal fellowship which she felt had import for a later era. Miss Suckow's stories and novels, although repetitious in subject and restricted in themes and character types, capture the various aspects of folk life in the early part of the century with validity and poignancy.

Microfilm \$3.60; Xerox \$12.60. 280 pages.

THE VITAL CONNECTION:  
A STUDY OF THE NEW REPUBLIC MAGAZINE  
AS A LITERARY JOURNAL,  
1914-1922.

(L. C. Card No. Mic 60-3701)

George Austin Test, Ph.D.  
University of Pennsylvania, 1960

Supervisor: Professor Robert E. Spiller

By following the course of the literary contents of *The New Republic* from its founding in 1914 to a significant turn in its affairs in 1922, by analyzing the ideas and writings of its founding editor, its literary editor, staff members and regular contributors, and by showing how the magazine mirrored the literary life of the period, this study shows how and why *The New Republic* was a literary journal of merit (as well as a recognized journal of political and social comment).

Chapter I gives the background of the founding, by tracing the ideas of Herbert Croly, founder and first editor, who as editor of the *Architectural Record* from 1900 to 1913 worked out his ideas of a cultural renaissance based on a resurgent nationalism expressed in *The Promise of American Life* (1909), thereby becoming a leading spokesman for the emerging Progressivism. With the financial backing of Willard and Dorothy Whitney Straight *The New Republic* began as an expression and instrument of Croly's cultural idealism. Chapter I also describes the social, journalistic and literary context in which the magazine began, and its first board of editors, Walter Lippmann, Walter Weyl, Francis Hackett, and Philip Littell.

Chapter II gives a life of Francis Hackett, *The New Republic's* first literary editor, his ideas of the function of literature and criticism, and his attitude toward American literature and culture. Now forgotten, Hackett was then a leading critic of an important journal.

Chapter III describes the place on the magazine of Randolph Bourne, Philip Littell and Elizabeth Shepley Sergeant. *The New Republic* was the first important outlet for the literary radicalism of Bourne, and although he split with it over its war policy, they shared a desire for a cultural resurgence. Littell's province was a column of literary causerie, "Books and Things." Elizabeth Sergeant was the magazine's first foreign correspondent, originally reporting on the French literary scene, but after American entry, on the war itself.

Chapter IV deals with the articles and reviews of staff writers and other regular contributors: George Santayana, Harold Stearns, George Soule, Maxwell Anderson, Louis Untermeyer, Constance Rourke, Padraic Colum, Floyd Dell, Amy Lowell, Edith Wyatt, Percy Boynton, Robert Herrick, Samuel Chew, Rebecca West, H. G. Wells, Lytton Strachey and others.

Chapter V analyzes those articles and reviews that played a part in the controversy over "the new poetry." This chapter also discusses the coverage of the theatre, through play reviews by Hackett and "Q.K.," and articles on drama by Alfred Kuttner, Robert E. Rogers, Kenneth MacGowan, Hiram Moderwell, and Oliver S. Saylor.

Chapter VI describes and evaluates the poetry, fiction and essays published in the magazine, and establishes its critical position vis-a-vis the literary radicals, especially Van Wyck Brooks, Waldo Frank and H. L. Mencken, and its

concept of the function of criticism in and attitude toward the current literary groundswell.

Chapter VII concludes the study by showing how *The New Republic* encouraged new ideas, new writers and the new literature, thereby playing a vital role in the literary renaissance of the twentieth century.

Microfilm \$3.70; Xerox \$13.05. 288 pages.

#### LACLOS AND THE EPISTOLARY NOVEL

(L. C. Card No. Mic 60-3149)

Dorothy Ramona Thelander, Ph.D.  
Columbia University, 1960

The epistolary form which Choderlos de Laclos perfected is not only an eighteenth-century phenomenon. The introductory chapter of the present study traces the use of both real and fictional letters by religious and secular writers who wished to narrate, instruct, satirize, give reality to their work, and present differing views of one or more given situations down through the ages.

In that chapter devoted to the composition and publication of *Les Liaisons dangereuses*, we surmise from the printer's contract, manuscript, early editions, and an admission of Laclos, that he wrote his novel between 1779 and 1781, after deciding that his army career could not bring lasting fame. The extant manuscript seems to be the version immediately prior to the printer's copy, while the recently discovered "B" copies are clearly examples of the true second edition.

A careful analysis of *Les Liaisons dangereuses* reveals it to be an almost perfect epistolary novel. All the major characters are motivated to write to each other and the problems of double narration and time lapse are handled with great economy and artistry. The three plots, however, do not relate satisfactorily to each other, except by a series of coincidences, and this despite Laclos' statement that he created *La Présidente* to come between Valmont and Mme de Merteuil. The ending, especially, betrays arbitrary intervention by the author. Although Valmont and Mme de Merteuil are destined to become avowed enemies, neither a duel nor smallpox is a logical denouement.

The three protagonists strive to subordinate emotion to reason. Valmont pictures himself as a model rake and battles with his sensibilities. Mme de Merteuil wishes to conceal her feelings to avoid being dominated and, ultimately, to dominate others. *La Présidente's* failure to reconcile religion and passion results in a complex emotional situation with remorse as but one factor.

Both major and minor characters portrayed by Laclos share the belief that they must act in order to secure what they want, thus implying the premises that society is hostile to the individual's wishes and that emotion can be wholly suppressed. But if Laclos showed various modes of adjustment to such a society and proved that none brings true happiness, he suggested that the reader should not himself adopt the impersonal and nonjudgmental tone of the book.

The tone depends on the relentless self-analysis of the major characters, on the contrast between the plotters' letters and those of the dupes, and, finally, on the style of the letters themselves. Vocabulary, metaphor, and sentence structure create and reinforce personality and

mirror its change throughout the novel. The control Valmont and Mme de Merteuil attempt to impose is emphasized by the theatrical analogies and by the arrangement of the action into scenes with dialogues and stage settings.

Though Laclos indicated that his characters must be judged from an ethical viewpoint, he did not present any solution of his own. It is impossible to consider *Les Liaisons dangereuses* as being solely about the war of the sexes, or as the inevitable conflict of two domineering individuals, or as a geometric exercise in eroticism, or as merely a revolutionary pamphlet. Laclos has written about a society with fundamental problems it would not examine--and which still remain unsolved. Even in the present instance, the epistolary form, while admirably suited to the careful analysis of emotion and action, falls short of providing sufficient illumination for the reader to judge the author's intentions without the danger of creating his own novel.

Microfilm \$3.70; Xerox \$13.05. 286 pages.

#### ACEDIA AND RELATED TERMS IN MEDIEVAL THOUGHT, WITH SPECIAL EMPHASIS ON MIDDLE ENGLISH LITERATURE.

(L. C. Card No. Mic 60-4143)

Siegfried Wenzel, Ph.D.  
The Ohio State University, 1960

Modern literary critics have frequently asserted that sentiments like Romantic melancholy and *Weltschmerz* had their predecessor in medieval *acedia*. At the same time, Petrarch scholars believe that the transition from the medieval to the modern sentiment can be found in Petrarch's treatment of *accidia* in his *Secretum*. This relation, however frequently affirmed, has never been studied in detail or proved beyond doubt. Likewise, no detailed investigations of the medieval concept of *acedia* have been made. Existing shorter discussions of the subject are incomplete, either because they neglect the early history of the term or because they consider only theological literature.

The present study presents the history of *acedia* from its beginnings to the fifteenth century, with an emphasis on Middle English literature. It is an attempt to show what the term meant to medieval man, insofar as this can be determined by analyzing descriptive passages from theological, devotional, and secular writings. The investigation is strictly concerned with the semantic history of the term and disregards texts which deal with psychological states similar to *acedia*, but which do not use the word.

Chapters I and II trace the history of the word from its beginnings among the Egyptian desert monks--especially Evagrius Ponticus--through Latin theological writings to the scholastic synthesis. In chapters III and IV the Middle English analogues of *acedia*--"accidie" and "sloth"--are examined as they appear in vernacular devotional literature and in the English mystics. Chapter V discusses the appearance of the concept in medieval belles-lettres and analyzes relations with "idleness," medieval attitudes toward labor, and the gradual widening of meaning of the word "sloth" from neglect of spiritual matters to plain indolence. Chapter VI examines Petrarch's treatment of



accidia and shows the very close affinity of his term with the medieval concept. In chapter VII, finally, an attempt is made to show several important differences between acedia and forms of modern melancholy and to suggest a common basis for the two sentiments in general human experience.

The investigation shows, first, that acedia referred to the sin of spiritual sloth and that it was firmly connected with the scheme of the seven capital sins. This connection already existed in the work of Evagrius Ponticus. Second, the concept had reached a mature stage as early as Evagrius. In its further history theologians in the West adapted the term to new conditions, clarified its nature, and determined its precise place in the moral-theological system, but did not modify it essentially. Third, acedia was a very complex concept, covering a wide variety of phenomena, which ranged from numerous faults of spiritual neglect committed by the common layman to subtle temptations like the absence of spiritual consolations and joylessness. Finally, in non-devotional literature from the thirteenth century on, the concept was widened to include the neglect of duties not strictly religious. Against this background, Petrarch's accidia appears as a true form of the medieval vice, though highly "secularized" and adapted to the moral life of the humanist. Whether Petrarch considered accidia as a positive quality--like Renaissance melancholia--cannot be demonstrated.

Microfilm \$3.60; Xerox \$12.60. 278 pages.

A STUDY OF THE SOURCES OF GERMINAL  
BASED UPON AN EXAMINATION OF  
ZOLA'S MANUSCRIPTS, NOTES,  
AND THEIR SOURCES.

(L. C. Card No. Mic 60-4820)

Richard Hachadoor Zakarian, Ph.D.  
Northwestern University, 1960

Adviser: William T. Starr

This study of Germinal complements the dissertation by Philip Walker, "A Structural Study of Germinal Based Upon an Examination of Zola's Manuscript Notes for the Novel," (Yale, 1956), which emphasizes the contribution of his creative documents to the stylistic and structural development of the novel. We concentrate on the published texts consulted by Zola, on his notes from personal oral and written communications, and on his notes from an on-the-scene investigation of Anzin, 1884. A study of the notes in the Bibliothèque Nationale (MS. 10.308) indicates that the raw materials which went into the creation of the novel may be classified into three general areas: 1) technical, historical, and scientific data on the organization,

operation, and administration of the mining industry and the complex sociological, psychological, and medical details of a mining community; 2) the history of strike manifestations in France from 1869 to 1884; 3) information on the social, political, and economic problems and philosophies after 1850. A study of the primary sources rather than Zola's brief notes based on the published works (Zola worked incontrovertibly from the primary sources) presents a valid picture of Zola's borrowings. Whenever it has been possible to determine the primary text, we have made a comparison of it with the pertinent paragraphs of the novel. Such a study reveals much not only about the development and elaboration of Germinal but about the creative techniques and documentary procedures of the artist.

This study indicates that most of the technical, historical, and medical substance of Germinal was contained in texts (Dormoy, Simonin, Boëns-Boissau, Blanc) contemporary with the dates of the action (1866-1867) in the novel, while the political, economic, and social content of Germinal came from studies (Stell, Laveleye, Guyot, Testut, Leroy-Beaulieu) and events contemporary with the dates of the book's composition (1883-1884). Most of Zola's textual material is tempered by the significant Anzin notes, all of which ultimately found their way into the novel. Such a detailed study of the factual materials permits one paramount conclusion: Zola, for the most part, remained faithful to his documents in language as well as substance. Any modification of the document was to facilitate a more efficient, economic, and successful adaptation into the novel. Zola modifies for obvious thematic or artistic reasons. This study permits the formulation of certain generalizations concerning Zola's techniques of assimilation, synthesis, transformation, and adaptation of the factual documents. First, Zola excludes the extraneous and the inappropriate materials which he has amassed. He translates highly technical explanations into simplified, readable language, heedful not to bore his reader. Secondly, the author may take one factual incident and fictionalize it to soften or exaggerate the event or fact. Thirdly, Zola tends to take several historical incidents and to compress them into one or two outstanding fictional scenes. Finally, the converse of this principle--the expansion of one historical event or fact into several fictional incidents--is as much in evidence.

It would be folly for the critic to judge Germinal as if it were a treatise or a statistic and Zola as if he were an historian or specialist (Zola admittedly falsifies or uses anachronism when his aims necessitate his doing so). Zola, the novelist, never loses sight of the central theme and his adaptation of the document is tailored to this unifying element which is the very source of the novel's strength. In conclusion, Zola reproduced his documents without modification in idea and with the normal literary, stylistic, and thematic concerns of a novelist.

Microfilm \$4.15; Xerox \$14.65. 323 pages.

## MATHEMATICS

### $L_p$ DENSITY OF SOLUTIONS TO PARABOLIC AND RELATED EQUATIONS ON SPACE TIME SURFACES

(L. C. Card No. Mic 60-3498)

Robert Duke Adams, Ph.D.  
University of Minnesota, 1960

Adviser: A. N. Milgram

Let  $\Omega$  be a bounded, measurable subset of  $E^n$  with positive measure,  $f(x) = f(x_1, \dots, x_n)$  a polynomial in  $E^n$  with constant coefficients. Define:

- a)  $S = \{(x, t) \mid t = f(x), x \in \Omega\}$  a surface in  $E^{n+1}$  above  $\Omega$ ,  
b) the  $L_p$ -norm on  $S$  by

$$\|V\|_{p,s} = \left[ \int_S |V(x, t)|^p dA_s \right]^{1/p} \quad 1 \leq p < \infty$$

where  $dA_s$  is an element of area ( $n$ -dim.) on the surface  $S$ .

It is shown in this paper that if

- i)  $L(\frac{\partial}{\partial t}) = L(\frac{\partial}{\partial x_1}, \dots, \frac{\partial}{\partial x_n})$  is a homogeneous differential operator with constant coefficients and  
ii)  $f(x) = L(c_1 x_1, \dots, c_n x_n) + l(x_1, \dots, x_n)$  or  
 $f(x) = l(x_1, \dots, x_n)$

where  $\deg L(x) > \deg l(x)$  and  $c_\nu > 0, \nu = 1, \dots, n$ ;  
then, for any bounded set  $\omega \subset E^n$  with positive measure, the set of functions

$$u(x, t) = \int_\omega \phi(\alpha) \exp(ix \cdot \alpha + L(i\alpha)t) dV$$

where  $dV_\alpha$  is an element of volume in  $E^n$ ,  $\phi$  is bounded, and  $x \cdot \alpha = \sum_{k=1}^n \alpha_k x_k$ ; are solutions of the partial differential equation

$$L(\frac{\partial}{\partial x}) u(x, t) = \frac{\partial}{\partial t} u(x, t)$$

and are dense in  $L_p(S)$ , the space of functions which are defined and measurable on  $S$  and with finite  $L_p$ -norm on  $S$ .

In the case where the  $x$ -space is of dimension one the assumption of positivity of the  $c_\nu$ 's can be relaxed obtaining the slightly stronger theorem by changing ii) to read:

- ii)  $f(x) = c_m x^m + \dots + c_0$  where  $m$  is the order of the operator (and without loss of generality the coefficient of

the operator is assumed positive)  $c_m$  arbitrary except possibly for a countable set of negative numbers.

Microfilm \$2.50; Xerox \$3.00. 33 pages.

### MIDPOINT LOCAL UNIFORM CONVEXITY, AND OTHER GEOMETRIC PROPERTIES OF BANACH SPACES.

(L. C. Card No. Mic 60-3875)

Kenneth Wayne Anderson, Ph.D.  
University of Illinois, 1960

Geometrically, midpoint local uniform convexity (m.l.u.c.) states that if the midpoint of a variable chord in the unit ball approaches a fixed point on the surface of the unit ball, then the length of the chord approaches zero. It is shown that this property lies between local uniform convexity (l.u.c.) and rotundity (sometimes called strict convexity), and some sufficient conditions for m.l.u.c. are determined. In the case of a reflexive Banach space, still another convexity property is found between l.u.c. and m.l.u.c., and is shown to be dual to strong differentiability of the norm. It is also proved that if  $B^*$  is separable, then  $B$  is isomorphic to an l.u.c. space.

Microfilm \$2.50; Xerox \$3.00. 52 pages.

### THE USE OF STATISTICAL TECHNIQUES IN MEDICAL AND DENTAL PAPERS: A CRITIQUE.

(L. C. Card No. Mic 60-3734)

Herbert Richard Axelrod, Ph.D.  
New York University, 1960

Chairman: Professor John Kinsella

#### The Problem

The problem selected is to determine the statistics needed for the understanding and solution of a randomly chosen group of medical and dental research problems. It is apparent from general reading that such problems are often mishandled and that incomplete information is gained or even wrong conclusions made because of inadequate planning and analysis.

A number of previous studies have investigated the frequency with which various techniques were used, but none is recent and none specifically in medical research. Other studies have investigated the teaching practices of institutions, and one recent report intended for the guidance of medical and dental research workers gives a



series of detailed examples for researchers to follow. No one seems previously to have investigated the medical and dental literature in order to determine what is going on statistically, and to form opinions of how adequately statistical methods are used and what should be taught to students and researchers.

### Procedure

All research papers which used statistical methods were noted for the years 1949-54 inclusive in the "Journal of the American Medical Association" or in the "Journal of Dental Research." Random samples of 20 papers were selected from each of these journals. These papers were then analysed in detail to discover how adequately the work was designed and analysed and what were the various techniques employed or that should have been employed.

As the investigation proceeded, it became clearer that the investigator's opinion of the statistical methods that should have been used must take precedence in recommendations. This occurred because so many of the studies were inadequately designed or analysed and because modern statistical techniques were so often omitted when they were appropriate.

Tables were eventually prepared showing the frequency with which various techniques were used or should have been used, and the frequency with which the design or the analysis was adequate.

### The Findings

Only thirty-eight of the research papers could be statistically examined, and of these twenty showed evidence of adequate design. Analysis was adequate in only twelve of the studies, while both design and analysis were together adequate in eleven of these twelve.

The various statistical techniques of outstanding importance were tabulation (needed in all studies), the arithmetic mean (needed in nineteen studies), percentages (needed in seventeen studies), analysis of variance (needed in fourteen studies), graphing, chi-square tests and correlation in various forms (all needed in eleven studies).

A considerable increase is recommended in the use of advanced techniques such as the analysis of variance, compared with their actual usage. A suitable course for medical or dental students, beside covering the elements of statistics, must give emphasis to planning and must introduce the analysis of variance, chi-square tests and correlation, but need only outline briefly other advanced techniques so that the need for them may be recognized when it arises.

Editors of journals such as those examined should be told of the situation in respect of statistics in research papers and should be prepared to seek statistical opinion on papers submitted and to offer assistance to the contributor.

Further studies could profitably inquire into such questions in related fields, and into the prevalence and desirability of statistical training in the medical and related fields. They could examine the feasibility of requiring that statistical "vetting" be compulsory in research institutions. The advisability of mathematical statistical courses as against more purely "applied" courses should be examined.

Microfilm \$5.20; Xerox \$18.45. 408 pages.

### COMPUTER LOGIC PROGRAMS

(L. C. Card No. Mic 60-3879)

Geneva Grosz Belford, Ph.D.  
University of Illinois, 1960

Computer "logic" programs are essentially computer programs capable of analyzing other computer programs. In other words, while an ordinary computer program may be thought of as operating on given data to produce a (usually numerical) result, a logic program operates on given programs to produce some sort of information about those programs. Such a logic program might, for example, be used to prove mathematical theorems once the operations of a mathematical system have been defined in terms of computer programs.

Because the order codes of real computers are too complicated (containing orders of many different kinds) to be readily amenable to analysis, an imaginary, ideal computer was invented for an initial attempt at program analysis. This ideal computer is assumed to have an infinite, "associative" memory; that is, the information held in the memory consists of an infinite set of symbols and a relationship associating to every ordered pair of symbols from the set a unique third symbol from the set. The order code of this computer consists of a single order --a "symbol transfer" in the following sense: An ordered set of four symbols a, b, c, d is specified. Then the symbol transfer causes a change in the association relationship for the memory, associating to the symbol pair c,d that symbol which is associated to a,b. It is shown that non-trivial operations are able to be carried out on this computer, and that it is, in fact, able to compute any function computable by a Turing machine.

Various approaches toward program analysis are discussed. The best one appears to be a straight-forward examination of a program order-by-order, beginning at the first order of the program to be obeyed by the computer. All pertinent information is stored into a large chart, which allows ready access to information about previous orders. Theoretically, examination of this chart should allow one to determine program behavior at any time.

Certain difficulties which arise in program analysis are described. For example, a program may contain finite or infinite "loops," or some order of a program may alter a later order. Some methods of getting around these difficulties are discussed. A number of special program types are looked at in detail, to determine under what circumstances they are readily analyzed.

Finally, a prototype logic program, capable of analyzing many non-trivial programs, is outlined in flow-chart form. Areas of possible improvement are pointed out and discussed.

Microfilm \$2.50; Xerox \$4.20. 79 pages.

THEORY AND APPLICATIONS OF  
THE SEQUENTIAL DESIGN OF EXPERIMENTS,  
k-ACTIONS AND INFINITELY MANY EXPERIMENTS.

(L. C. Card No. Mic 60-3791)

Stuart Alan Bessler, Ph.D.  
Stanford University, 1960

An experimenter observes a phenomenon which is governed by an underlying parameter  $\theta$ . Let  $\Theta$  denote the space of possible parameter points. He wishes to choose from the space of available actions,  $A$ , the action,  $a$ , which best describes the phenomenon. It is assumed that corresponding to each possible parameter point there is one and only one best action.

To aid the experimenter in his choice of the appropriate action the experimenter may perform, at a cost of  $c$  units, an experiment which has been selected from a space of available experiments,  $\mathcal{F}$ . The outcome of the experiment is a random variable which depends on the state of nature and the experiment performed. Experimentation is continued until the experimenter has accumulated sufficient information to conclude experimentation and announce his results.

At each stage of the experimental process the experimenter must decide either to stop experimenting in which case he must choose an action, or continue experimentation in which case he must choose an experiment with which to continue. The rule with which these decisions are made will be called the sequential decision procedure. The performance of a sequential decision procedure is measured by its risk which is the "average" loss resulting from the cost of experimentation and the cost of incorrect decisions.

The thesis is divided into two parts. In Part I a sequential decision procedure, procedure  $D^*$ , is suggested for the problem in which the action space and the parameter space are each finite while the space of available experiments is infinite. It is shown, for a class of problems which satisfy certain conditions, that procedure  $D^*$  is asymptotically (as  $c \rightarrow 0$ ) optimal in the sense that for any procedure to have risk substantially less than that of procedure  $D^*$  for any  $\theta \in \Theta$  necessitates that its risk will be of a greater order of magnitude for some  $\theta \in \Theta$ .

In Part II several examples are considered. Examples 5 and 6 present a design for determining which of three populations with common variance has the greatest mean. Previous literature on this problem has discussed only the stopping-terminal action rule, and not the problem of experiment selection.

Example 1 presents a design for recognizing the unique coin in a group of  $k$ -otherwise identical coins.

Examples 3 and 4 present a design for identifying several known but "untagged" populations.

Example 2 is concerned with the problem of checking the reliability of a two component system. Should the system reliability be substandard the procedure enables the experimenter to identify the substandard component. Included in the example is a criterion for determining whether to perform tests on the components before or after their assembly.

For each example the asymptotic risk of a popular alternative procedure has been obtained. The ratio of the asymptotic risk of procedure  $D^*$  to that of the alternative is defined as the efficiency of the alternative procedure.

For each example the efficiency has been computed and tabled. Microfilm \$2.50; Xerox \$6.20. 127 pages.

MARTINGALES OF BANACH-VALUED  
RANDOM VARIABLES

(L. C. Card No. Mic 60-3409)

Srishti Dhar Chatterji, Ph.D.  
Michigan State University, 1960

Major Professor: Charles H. Kraft

The main purpose of the thesis is to consider conditional expectations of r.v.'s which take values in a Banach space and to study the limit properties of certain sequences of such r.v.'s. These sequences are called martingale sequences, following the terminology of Doob. We first of all demonstrate that every Bochner-integrable r.v. has a conditional expectation relative to any Borel-field and establish some of the basic properties of conditional expectations. Then we go on to study the convergence in the mean and convergence almost-everywhere of martingale sequences. This we have done by studying operators on certain generalized Lebesgue-spaces, discussed in our Chapter 11. We have established the generalizations of most of the theorems of the classical theory of martingales and have shown by a counter-example in Chapter 1V that some restrictions on the Banach space in which the r.v.'s take value, are necessary. In the last chapter, we have considered some applications of our theory.

Microfilm \$2.50; Xerox \$4.60. 90 pages.

INTEGRATION IN INFINITE PRODUCT SPACES

(L. C. Card No. Mic 60-4597)

Samuel Henry Coleman, Ph.D.  
University of Virginia, 1960

This paper attempts to resolve some of the difficulties encountered in the theory of probability measures on infinite product spaces by application of a generalization of the Daniell theory of integration. The generalized theory used here is due to McShane and Bourbaki.

For each  $t$  in a parameter set  $T$ , let  $X_t$  be a (fixed) compact Hausdorff space, and let  $X = \prod_{t \in T} X_t$ . A function

$f$  on  $X$  is finitely (countably) based if it depends only on a finite (countable) number of coordinates. The set of finitely-based continuous functions on  $X$  is a set of Daniell elementary functions, and an integral  $I$  on this set which satisfies consistency conditions analogous to those of Kolmogorov is a Daniell elementary integral. In the generalized theory,  $I$  is extended first to an upper class of functions which are the suprema of (uncountable) sets, directed by  $\geq$ , of elementary functions. An integral  $I$  is then defined in the Daniell manner.

The measure resulting from this integral is a regular Borel measure. The measure of an open set is the



supremum of the measures of the finitely-based open sets contained in it (and dually for closed sets). The stochastic process (of function-space type) defined by this measure is separable in the sense of Doob. A stronger theorem useful for applications is: if  $f$  is a lower semi-continuous real-valued function on  $X_t \times X_t$ , if  $S_2$  is a subset of  $T$  and if for each  $s_2$  in  $S_2$ ,  $S_1(s_2)$  is a subset of  $T$ , then the function  $F$  defined for each  $x$  in  $X$  by  $F(x) =$

$$\sup_{s_1 \in S_1(s_2), s_2 \in S_2} f(x(s_1), x(s_2)) \text{ is measurable and is equal}$$

almost everywhere to the corresponding supremum over an appropriate countable subset of  $T$ . Under the usual mild continuity conditions on the elementary integrals, this countable subset can be taken to be an arbitrary dense set.

If  $X_t$  and  $T$  are metric, application of the above theorem to the metric of  $X_t$  shows measurability of the functions: oscillation of  $x$  at  $t$ , left (right) oscillation of  $x$  at  $t$ , and if  $T$  and  $X_t$  are compact intervals, the total variation of  $x$  in  $T$ . Measurable sets include: functions  $x$  continuous at  $t$ , functions continuous on  $T$ , functions satisfying a Holder condition with any positive exponent, functions with left or right limits at  $t$ , functions with at worst jump discontinuities, and if  $X_t = [-\infty, \infty]$  the bounded functions and the functions of bounded variation.

A general theorem on change of variables in function-space integrals is applied to obtain a new proof of the Cameron and Martin theorem on transformation of the Wiener integral under translations.

Microfilm \$2.50; Xerox \$3.00. 39 pages.

#### SINGULAR NONLINEAR INTEGRAL EQUATION WITH COMPLEX VALUED KERNELS OF TYPE N

(L. C. Card No. Mic 60-3895)

Charles Gladstone Costley, Ph.D.  
University of Illinois, 1960

This dissertation concerns itself with a study of the nonlinear integral equations

$$1. \quad \phi(x) + \int_0^1 K(x,t)f(t,\phi(t))dt = 0$$

$$2. \quad \phi(x) + \int_0^1 \Gamma(x,y,\phi(y))dy = 0$$

where

$$\Gamma(x,y,z) = \int_0^1 K(x,t)p(t,y,z)dt.$$

$\phi(x)$  is the unknown function in either case. The kernels

$$K(x,t) = K'(x,t) + iK''(x,t)$$

are singular, of type N. Singular type N kernels are defined as kernels satisfying the following conditions:

(i)  $K(x,y)$  is complex valued and measurable in the square  $0 \leq \frac{x}{y} \leq 1$ .

(ii) The integrals  $\int_0^1 |K(x,t)|^2 dt$  and  $\int_0^1 |K(x,t)|^2 dx$

exist for almost all  $x$  and  $t$  respectively, while

$$\int_0^1 \int_0^1 |K(x,t)|^2 dx dt \text{ is possibly nonexistent.}$$

(iii) There exists a sequence  $\{K_n(x,y)\}$  of regular kernels converging to  $K(x,y)$  and satisfying

$$\sum \frac{1}{|\lambda_{mj}|^2} = \int_0^1 \int_0^1 |K_m(x,y)|^2 dx dy \quad (\text{condition 1}).$$

Spectral functions for type N kernels are defined and some of their properties discussed. It is shown that if

$$K(x,y) = K'(x,y) + iK''(x,y)$$

is singular of type N, then

$$\int_0^1 K'(x,t)K''(t,y)dt = \int_0^1 K''(x,t)K'(t,y)dt$$

and

$$\int_0^1 K(x,y)g(y)dy = \int_B \frac{1}{\lambda} dA(x,yy; \Omega_\lambda) g(y)dy$$

for almost all  $x$  and for each  $g(x)$  in  $L_2$ . The subscript  $\lambda$  with  $\Omega$  indicates the variable point in the  $\lambda$ -plane with respect to which the integration is performed and  $B$  is any bounded Borel set in the  $\lambda$ -plane.

The familiar representation

$$K_m(x,y) \sim \sum_{j=1}^{\infty} \frac{1}{\lambda_{mj}} \phi_{mj}(x) \overline{\phi_{mj}(y)}$$

(convergence in the mean square in  $(x,y)$ ) for the approximating kernels, makes this class of kernels particularly suitable for a spectral theory. These kernels actually form the widest class of kernels which may be expressed in terms of characteristic functions and characteristic values in the manner above.

Under suitable restrictions on the functions  $f$ ,  $p$  and  $h$ , existence and uniqueness theorems on solution of equation 1 are obtained. A spectral representation is also given for such a solution.

Similar theorems are obtained for solution of equation 2. A space  $L_\phi^2$  is constructed in which singular type N kernels are regular and in which the equations 1 and 2 can be discussed by regular methods of operators in a Hilbert space. Microfilm \$2.50; Xerox \$3.00. 49 pages.

#### A CLASS OF STOCHASTIC INVESTMENT PROBLEMS

(L. C. Card No. Mic 60-5212)

James L. Fisher, Ph.D.  
Case Institute of Technology, 1960

A decision maker, faced with investment opportunities which occur throughout time, must, when confronted with a particular investment, decide whether to accept the investment. The problem of determining optimal decision rules under these conditions is formulated as a stochastic process which can be analyzed by the functional equation of dynamic programming. Investment opportunities are first considered to occur at regular intervals in time. This is then generalized so that, in the limit, opportunities

can occur at random. Some simple investment problems involving a decision maker with fixed assets are solved and numerical results presented. As an extension of these simple situations, a problem of investing a stream of assets is solved. As an illustration of the methods, two numerical problems based on business applications are solved and optimal decision rules presented.

Microfilm \$2.50; Xerox \$5.40. 109 pages.

# THE CONSTRUCTION AND EVALUATION OF SOME DESIGNS FOR THE ESTIMATION OF PARAMETERS IN RANDOM MODELS

(L. C. Card No. Mic 60-3722)

David William Gaylor, Ph.D.  
North Carolina State College, 1960

Supervisor: Richard Loree Anderson

This dissertation considers methods of sampling, with fixed sample size  $N$ , which would lead to good estimates of components of variance in a two-way crossed classification model with  $n_{ij}$  observations in the  $(i,j)$  cell:

$$y_{ijk} = \mu + r_i + c_j + (rc)_{ij} + e_{ijk},$$

where the effects  $r_i$ ,  $c_j$ ,  $(rc)_{ij}$ , and  $e_{ijk}$  are normally and independently distributed random variables with zero means and variances  $\sigma_r^2$ ,  $\sigma_c^2$ ,  $\sigma_{rc}^2$ , and  $\sigma_e^2$ , respectively.

It was shown that the lower bound for the variance of an unbiased quadratic estimator of a linear function of components of variance with expected value,  $\sigma^2$ , is  $2\sigma^4/(N-1)$  where  $N$  is the total number of observations. Procedures which achieved the lower bounds were determined for estimating  $\sigma_e^2$ ,  $(\sigma_e^2 + \sigma_{rc}^2 + \sigma_r^2)$ ,  $(\sigma_e^2 + \sigma_{rc}^2 + \sigma_c^2)$ , and  $(\sigma_e^2 + \sigma_{rc}^2 + \sigma_r^2 + \sigma_c^2)$ . In estimating other functions of the variance components, optimal allocation depends upon the estimators used. The estimator for  $\sigma_r^2$  was obtained by equating mean squares to their expected values in an analysis of variance based on the method of fitting constants, where the row mean squares is adjusted for column effects and interaction is adjusted for both row and column effects.

A procedure was developed to minimize the variance of  $\hat{\sigma}_r^2$  when  $n_{ij} = 0$  or  $n$ ; for this case, it was shown that  $n = 1$ .

From the same analysis of variance used to estimate  $\sigma_r^2$ , an estimator of  $\sigma_r^2/(\sigma_e^2 + \sigma_{rc}^2)$  can be obtained from the ratio of the row to interaction mean squares. The form of the design of the type  $n_{ij} = 0$  or  $1$  which minimized the variance of this estimator was determined.

Allocation for estimating  $\sigma_c^2$  and  $\sigma_c^2/(\sigma_e^2 + \sigma_{rc}^2)$  were treated similarly.

A few tentative conclusions on the simultaneous estimation of  $\sigma_r^2$  and  $\sigma_c^2$  were obtained. Two types of designs were compared.

Procedures were developed for both the one-way nested and two-way crossed classifications to find the approximate minimum value of  $N$  such that the variance of the estimators of components of variance were less than specified values.

A procedure was developed for the one-way nested classification which minimizes the approximate variance of an estimator of the total variance subject to a fixed total cost where the cost of sampling classes is not necessarily equal to the cost of sampling within classes.

Microfilm \$2.50; Xerox \$4.80. 95 pages.

# INFERENCE ABOUT MARKOV CHAINS WITH NONSTATIONARY TRANSITION PROBABILITIES

(L. C. Card No. Mic 60-3072)

Ruth Z. Gold, Ph.D.  
Columbia University, 1960

Utilizing methods analogous to those of Neyman ("Contribution to the theory of the  $\chi^2$ -test," Proceedings of the Berkeley Symposium on Mathematical Statistics and Probability, University of California Press, Berkeley, 1949, pp. 239-274), results of Anderson and Goodman (Ann. Math. Stat., Vol. 28 (1957), pp. 89-110) concerning estimation and tests of hypotheses for the transition probabilities in finite nonstationary Markov chains based on a large number of observations taken at times  $t = 0, 1, 2, \dots, T$  are extended to the case where the transition probabilities are specified functions of unknown parameters. We also show that certain  $\chi^2$  expressions arising in Markov chains with arbitrary transition probabilities can be decomposed into a sum of squares of asymptotically independent normal variables with 0 means and unit variances after the manner of "partitioning" proposed by Lancaster (Biometrika, Vol. 36 (1949), pp. 117-129) despite the fact that in Markov chains the number corresponding to the number of observations in a contingency table is a random variable. A method of finding joint confidence intervals for linear combinations of transition probabilities as well as probabilities in independent sequences of multinomial trials analogous to that used in the analysis of variance is suggested.

Microfilm \$2.50; Xerox \$6.60. 140 pages.

# APPLICATION OF THE LOGISTIC MODEL TO ANALYZING CATEGORICAL DATA

(L. C. Card No. Mic 60-3723)

James Ennis Grizzle, Ph.D.  
North Carolina State College, 1960

Supervisor: Henry Laurence Lucas, Jr.

In this dissertation it is assumed that the data were obtained by sampling from several binomial distributions. Because of the form of the likelihood,

$$(1) \quad \prod_{i=1}^r \frac{n_i!}{a_i!b_i!} P_i(\theta) Q_i(\theta),$$



where  $a_i + b_i = n_i$ , some investigators have called this type of sample "a product binomial sample." The model

$$(2) \quad P_i(\theta) = \frac{1}{1 + \exp\left(-\sum_{k=1}^t x_{ik}\theta_k\right)}, \quad i = 1, \dots, r,$$

is assumed to describe the relation between the treatments and the response. For purposes of estimation and testing hypotheses, (2) is usually written

$$(3) \quad \frac{L}{r \times 1} = \frac{X}{r \times t} \frac{\theta}{t \times 1}$$

where  $L$  is a vector of elements  $\ell_i = \log_e \frac{P_i}{Q_i}$ , and  $\theta$

is estimated by a procedure that is similar to that of weighted multiple regression.

For data of this type, tests of two classes of hypotheses are investigated:

- (a) tests of the goodness of fit of the model, and
- (b) tests that linear functions of the  $\theta$ 's have pre-assigned values.

In cases where  $X$  is chosen so that a complete block design is formed, new methods of testing the hypotheses given by (a) and (b) are developed. Given  $P_i = P_i(\theta)$ , to test hypotheses of type (b), i. e.,

$$(4) \quad H_0: \frac{F}{u \times t} \frac{\theta}{t \times 1} = \frac{h}{t \times 1},$$

choose a set of restraints

$$(5) \quad \frac{F^*}{u \times r} \frac{L}{r \times 1} = \frac{h}{r \times 1},$$

where  $F^*L = F\theta$ , and obtain estimates of the  $P$ 's subject to (5). Or we may test hypotheses of type (a), i. e.

$$(6) \quad H_0: P_i = P_i(\theta)$$

subject to the restraints given by (5).

In testing the hypothesis given by either (4) or (6) we must solve for  $\lambda$ , equations of the form

$$(7) \quad \sum_{i=1}^r f_{ij}^* [\log(a_i - F_i^* \lambda) - \log(b_i + F_i^* \lambda)] = h_j, \\ j = 1, \dots, u,$$

where  $F_i^*$  is the  $i$ -th column vector of  $F^*$ . It is shown that if we restrict ourselves to solutions of (7) which will yield positive estimates of variance for each distribution sampled, there is not more than one useable solution,  $\lambda^*$ , say. The estimates of the  $P_i$ ,  $\hat{P}_i$ , are given by

$$(8) \quad \hat{P}_i = \frac{a_i - F_i^* \lambda^*}{n_i} \quad i = 1, \dots, r,$$

and the test statistics for testing the hypothesis given by (4) and (6) are respectively

$$(9) \quad X_1^2 = X_*^2 - X^2,$$

and

$$(10) \quad X_*^2 = (F^{*'} \lambda^*)' D^* (F^{*'} \lambda^*)$$

where  $X^2$  is obtained by fitting the model without restraints, and  $D^*$  is a diagonal matrix of elements

$1/n_i \hat{P}_i \hat{Q}_i$ . Both  $X_1^2$  and  $X_*^2$  have central chi square distributions with  $u$  d.f. if  $H_0$  is true. In some cases,  $\lambda^*$  associated with a certain  $F^*$  can be used to get maximum likelihood estimates of  $\theta$  without the iteration required by conventional methods. Newton's method is used to compute  $\lambda^*$ . Several examples are given.

Non-centrality parameters are found for the tests. For the test given by (4) against the alternative

$$(11) \quad H_a: H\theta - h = \frac{c}{\sqrt{n}}$$

where not all of the  $c$ 's are zero, the non-centrality parameter is

$$(12) \quad \Delta_1 = c' F_1^{-1} X_1' [D_w - D_w X_* (X_*' D_w X_*)^{-1} X_*' D_w] X_1 F_1^{-1} c,$$

where

$$X_* = X_2 - X_1 F_1^{-1} F_2;$$

$X_1$  and  $X_2$  are the partitions of  $X$ ,

$$X = \begin{bmatrix} X_1 & X_2 \end{bmatrix} \begin{matrix} r \\ t-u \end{matrix};$$

$F_1$  and  $F_2$  are the partitions of  $F$ ,

$$F = \begin{bmatrix} F_1 & F_2 \end{bmatrix} \begin{matrix} u \\ t-u \end{matrix},$$

and  $D_w$  is a diagonal matrix of elements  $\frac{n_i}{n} P_i^0 Q_i^0$ ,

where  $P_i^0$  is  $P_i(\theta)$  evaluated at the true value of  $\theta$ ,  $\theta_0$ . For the test of the hypothesis given by (6) against the alternative

$$(13) \quad H_a: P_i = P_i(\theta) + \frac{d_i}{\sqrt{n}},$$

where  $d_i + d_i' = 0$  and  $\frac{d_i'}{\sqrt{n}} = Q_i - Q_i(\theta)$ , the non-centrality parameter is

$$(14) \quad \Delta^* = d^{*'} [D_w^{-1} - X_* (X_*' D_w X_*)^{-1} X_*'] d^*$$

where  $d^*$  is a vector of elements  $\frac{n_i}{n} d_i$ . Applications to tests used in bioassay are made.

Lastly, some sampling investigations were conducted to ascertain the agreement of the five and one percent points of the test statistics with those of the chi square distribution. Agreement of the power predicted from the non-centrality parameters with that actually observed was investigated. On the basis of these investigations it appears that assuming the test statistics follow the chi square distribution results in conservative tests for small samples and that following Cochran's (1954) rules for sample size will not lead one astray. Also when the sample size is large enough for the test statistic to follow the chi square distribution the non-centrality parameters predict the power with adequate accuracy. A suggestion is made for significance tests for small samples that may be used when high speed computers are available.

Microfilm \$2.50; Xerox \$4.40. 83 pages.

SOME COMPARISONS OF SENSITIVITIES  
FOR TWO METHODS OF MEASUREMENT

(L. C. Card No. Mic 60-3724)

William LeRoy Hafley, Ph.D.  
North Carolina State College, 1960

Supervisor: Robert James Monroe

The problem of comparing the sensitivities of two measuring processes when both processes are applied to the same experiment is considered. It is assumed that an experiment may be carried out specifically for the purpose of comparing two methods of measurement, and that materials can be selected for such experiments which are known to span some practical range of the characteristic of interest. The exact values of this characteristic need not be known, only that different values are exhibited by the selected materials. The criterion considered for determining the most sensitive process is to select that process which better demonstrates the existence of a between-treatments component of variance (Model II of the analysis of variance); i.e., that method which gives the larger F-ratio for treatments from the analysis of variance. When both measurement processes are applied to the same experiment the comparison of the F-ratios from the analysis of variance will involve the comparison of correlated F-ratios. It is demonstrated how the results of the Pitman-Morgan test for equality of correlated variances can be applied to handle this correlation. Statistical tests are then developed for testing the hypothesis that the sensitivities of two measurement methods are the same. Two experimental situations are considered, namely: the situation where both measurement processes may be applied to the same experimental units, and the situation where each measurement process is applied to separate sub-samples from the same experimental units. Both tests require the use of an asymptotic normal approximation. However, it is demonstrated that this approximation is valid for sample sizes as small as five. The power of the tests is investigated and power curves are presented for several values of the parameters. The effect of changes in the correlation on the power of the tests is indicated. As a means of demonstrating the goodness of the approximate tests, the techniques used in obtaining these two tests are then applied to a third experimental situation, that situation where two independent but identical experiments are conducted and the measurement methods to be compared are applied to separate experiments. This situation has been considered previously and tables of critical values are available for the application of an exact test of the hypothesis of equal sensitivities. A table is presented comparing the critical values obtained for the approximate test with those given for use of the exact test. Finally, application of the test procedures developed for the situations where only one experiment is conducted are presented.

Microfilm \$2.50; Xerox \$3.80. 68 pages.

LEFT ASSOCIATED ELEMENTS  
IN A LINEAR ALGEBRA

(L. C. Card No. Mic 60-3399)

William John Orsan Hardell, Ph.D.  
Michigan State University, 1959

Major Professor: B. M. Stewart

Let  $M(n, \mathcal{A})$  be the set of all  $n$ -rowed square matrices over a linear associative algebra of order  $k$  over a field  $F$ . Assume  $\mathcal{A}$  has an identity element  $e$ . Note that  $M(1, \mathcal{A}) = \mathcal{A}$ . A matrix  $U$  in  $M(n, \mathcal{A})$  is unimodular if and only if there exists a matrix  $U^{-1}$  such that  $UU^{-1} = U^{-1}U = I$ , where  $I$  has  $e$ 's down the main diagonal and zeros elsewhere. Two matrices  $A$  and  $B$  in  $M(n, \mathcal{A})$  are left associates if and only if there exists a unimodular matrix  $U$  in  $M(n, \mathcal{A})$  such that  $UA = B$ . A set  $\mathcal{C}$  of matrices in  $M(n, \mathcal{A})$  is a canonical set if and only if the elements in  $\mathcal{C}$  are pairwise not left associates and every matrix in  $M(n, \mathcal{A})$  is the left associate of an element in  $\mathcal{C}$ .

Using well known structure theory for linear algebras we derive a special basis for  $\mathcal{A}$ . Certain of these basis elements are idempotent elements of  $\mathcal{A}$ . Let  $A^*$  be the second regular representation of  $a$  in  $\mathcal{A}$  with respect to the special basis.  $A^*$  is a  $k \times k$  matrix over  $F$  and is in  $M(k, F)$ . Let  $M^*(k, F)$  be the set of all matrices in  $M(k, F)$  that are representations of elements in  $\mathcal{A}$  with respect to the special basis for  $\mathcal{A}$ . Matrices in  $M^*(k, F)$  have a special block form and one row in each block corresponds to one of the idempotent basis elements. These rows are called idempotent rows. We then prove the following theorem: A necessary and sufficient condition that two elements in  $\mathcal{A}$  are left associates is that their second regular representations, with respect to any basis for  $\mathcal{A}$ , have the same Hermite normal form. The theorem is first proved using the special basis for  $\mathcal{A}$  and then it is shown that the theorem holds for any basis.

Next consider  $M(n, \mathcal{A})$ . We first note that  $M(n, \mathcal{A})$  is isomorphic to  $\mathcal{M} \times \mathcal{A}$ , where  $\mathcal{M}$  is a total matrix algebra of order  $n^2$  over  $F$ . Define  $A^E$  to be the matrix obtained from  $A$  in  $M(n, \mathcal{A})$  by replacing each element of  $\mathcal{A}$  in  $A$  by its second regular representation.  $A^E$  is an  $nk \times nk$  matrix over  $F$  and is called the enlarged matrix of  $A$ . We show that  $A^E$  is a "reduced" representation of  $A$ . From this and the preceding theorem we get the following theorem: A necessary and sufficient condition for  $A$  and  $B$  in  $M(n, \mathcal{A})$  to be left associates is that their enlarged matrices,  $A^E$  and  $B^E$ , have the same Hermite normal form.

Now assume that  $\mathcal{A}$  is given in terms of the special basis. We use the block form of matrices in  $M^*(k, F)$  and the theory of rectangular matrices over  $F$  to define a class  $\mathcal{C}$  of matrices in  $M^*(k, F)$ . The matrices in  $\mathcal{C}$  are such that one row in each block, which is a row that corresponds to one of the idempotent basis elements of  $\mathcal{A}$ , remains invariant under certain elementary row operations. We show that the matrices in  $\mathcal{C}$  are pairwise not left associates. Then for any element  $a$  in  $\mathcal{A}$  we give a finite procedure for finding a left associate of  $a$  in  $\mathcal{C}$ . Thus the class  $\mathcal{C}$  is a canonical set for  $\mathcal{A}$ .

Microfilm \$2.50; Xerox \$4.80. 91 pages.



### HIGH SUBGROUPS OF ABELIAN TORSION GROUPS

(L. C. Card No. Mic 60-4329)

John McCormick Irwin, Ph.D.  
University of Kansas, 1960

In an abelian group  $G$ , let  $G^1$  denote the subgroup of  $G$  consisting of all elements of  $G$  which are divisible by all positive integers; that is,  $G^1$  is the subgroup of  $G$  consisting of all elements of infinite height in  $G$ . Let  $H$  be a subgroup of an abelian torsion group  $G$ .  $H$  will be called a high subgroup of  $G$  if  $H$  is maximal with respect to disjointness from  $G^1$ . Concerning high subgroups we have the following Theorem: If  $H$  is a high subgroup of an abelian torsion group  $G$ , then  $H$  is pure in  $G$ . In problem IV of his book Abelian Groups, L. Fuchs asks, 'Let  $G$  be a  $p$ -group and  $H$  an infinite subgroup without elements of infinite height. Under what conditions can  $H$  be imbedded in a pure subgroup of the same power and again without elements of infinite Height?'

As an application of the above theorem we obtain a best answer to this question: Theorem: Any infinite subgroup  $S$  of an abelian torsion group  $G$  with  $S \cap G^1 = 0$  can be embedded in a pure subgroup  $K$  of  $G$  such that  $|K| = |S|$  and  $K \cap G^1 = 0$ .

Microfilm \$2.50; Xerox \$3.00. 27 pages.

### FOURIER SERIES

(L. C. Card No. Mic 60-4767)

Masakiti Kinukawa, Ph.D.  
Northwestern University, 1960

This paper consists of three chapters which are independent of each other, except for some points in Chapters 1 and 2.

Chapter 1 is concerned with contractions of Fourier coefficients and functions. Denote the Fourier series of a

function  $f(x)$  by  $\sum_{n=-\infty}^{\infty} c_n e^{inx}$ , then  $\sum_{n=-\infty}^{\infty} \varphi(c_n) e^{inx}$

is not necessarily a Fourier series even provided that  $\varphi(z) \in \text{Lip } 1$  in a neighborhood of the origin. Our main result is that if there exists a function  $W(x)$  such that

$|f(x)|^p \leq W(|x|)$  in  $(-\pi, \pi)$  and

$$\int_0^\pi x^{-3p/2} \left( \int_0^x W^{2/p}(u) u^2 du \right)^{p/2} dx + \int_0^\pi x^{-p/2} \left( \int_x^\pi W^{2/p}(u) du \right)^{p/2} dx < \infty,$$

then  $\sum \varphi(c_n) e^{inx}$  is a Fourier series of a function which belongs to the class  $L^p(-\pi, \pi)$  ( $1 \leq p < 2$ ), provided that  $\varphi(z) \in \text{Lip } 1$ . For example, if  $W(x)$  is decreasing and integrable in  $(0, \pi)$ , then all the requirements are satisfied. From this theorem we can derive the Paley-Wiener theorem; if  $f(x)$  is odd, positive, integrable and monotone decreasing in  $(0, \pi)$ , then its conjugate function  $\tilde{f}(x)$  is

integrable. Also we can derive that if  $|a_n - a_{n-1}| \leq K/n(\log n)^\gamma$  ( $\gamma > 1$ ) for  $n = 2, 3, \dots$ , then  $\sum_{n=2}^{\infty} a_n \cos nx$

is a Fourier series. We also discuss a dual of the above theorem and analogues for Fourier transforms.

Chapter 2 is concerned with the behavior of the transformations of a function  $f(x)$  defined by

$$T_H^\circ f = \int_x^\pi \frac{f(t)}{2 \tan t/2} dt \quad \text{and} \quad T_B^\circ f = \frac{1}{2 \tan x/2} \int_0^x f(t) dt.$$

The following result is interesting: If  $f(x)$  belongs to  $L_\infty(-\pi, \pi)$  (by which we mean the class of bounded measurable functions in  $(-\pi, \pi)$ ) and if  $f(x)$  is even, then  $T_H^\circ \tilde{f}$  and  $T_B^\circ \tilde{f}$  also belongs to  $L_\infty$ .

Chapter 3 is concerned with a convergence criterion for Fourier series. We generalize the Hardy-Littlewood theorem as extended by M. E. Noble (Quart. J. Math. 9(1958), 28-39) in such a way: Let us denote the Fourier

series of  $f(x)$  by  $\sum_{n=1}^{\infty} a_n \cos nx$ . Suppose that (i)

$$\int_0^t |f(x)| dx = o(t/\varphi(1/t)) \quad \text{as } t \rightarrow 0,$$

where  $\varphi(u)$  is positive, strictly increasing to  $\infty$  and continuous in  $u > 0$ . Further suppose that (ii) there are a sequence of positive integers  $\{n_k\} \rightarrow \infty$  and real numbers  $\{\lambda_{n_k}\}$  such that  $\lambda_{n_k} = o(n_k)$  and

$$\int_{\lambda_{n_k}}^{n_k} \{u \varphi(u)\}^{-1} du = O(1),$$

and such that

$$\liminf_{k \rightarrow \infty} \{ \min [s_m(0) - s_n(0)] \} \geq 0$$

$$(|m - n_k| \leq \lambda_{n_k}; |n - n_k| \leq \lambda_{n_k}; m > n),$$

where  $s_n(x)$  is the  $n$ -th partial sum of the Fourier series.

Then  $\lim_{k \rightarrow \infty} s_{n_k}(0) = 0$ .

Microfilm \$2.50; Xerox \$5.00. 98 pages.

### THE THEORY OF THE METRIC FUNCTION AND SOME STATISTICAL APPLICATIONS

(L. C. Card No. Mic 60-3558)

Huan Pao Kuang, Ph.D.  
University of Minnesota, 1959

In this thesis a metric of any pair of distributions has been defined and treated in some detail. A function  $M(F, G)$ , defined over each pair of elements  $F$  and  $G$  of a distribution space  $\Omega$  from  $\Omega \times \Omega$  to  $\Psi$ , where  $\Psi$  is the space of all nonnegative real numbers, is said to be a metric, if certain postulates are satisfied. By use of the metric defined, the decision problems were considered from the viewpoint of the risk function. Suppose a set of  $n$  independent observations  $x_1, x_2, \dots, x_n$  is known to be a stochastic variable,  $X$ , having an unknown distribution function,  $F(x)$ . Let  $\omega$  be a specified class of distributions which is defined by  $\omega = \{F_i(x)\}$  ( $i = 1, 2, \dots, k$ ). The problem considered is to find a decision procedure according to which, for a discrete distribution  $F$  and  $\delta > 0$ , it can be decided whether  $F \in \omega$  or  $M(F, G) > \delta$ .

The probabilistic inequalities regarding the metric were found to play an important role in evaluating the risk.

The first chapter introduces the definition of the metric and some basic properties concerning the metric. Also contained is the derivation of Theorem I showing that the risk can be made smaller than any positive value by choice of the number of observations. The second chapter presents the detailed proof of Theorem II which gives an inequality showing an upper bound of probability that a metric for a pair of distributions is smaller than any positive number. The third chapter shows that the metric makes the decision process applicable to certain statistical problems. A number of probabilistic formulas for practical applications are derived in this chapter. The fourth chapter deals with methods for evaluating the maximum eigenvalue of a matrix. In addition, an alternative proof of the well-known  $\delta^2$  process is given. Finally, the fifth chapter gives some numerical examples to which the metric theory is applied.

Microfilm \$2.50; Xerox \$3.80. 70 pages.

#### AN EXPERIMENT WITH WORKSHEETS IN GENERAL MATHEMATICS

(L. C. Card No. Mic 60-3754)

Sam Matlin, Ph.D.  
New York University, 1960

Chairman: Professor John J. Kinsella

##### The Problem

The purpose of this investigation was to compare certain results of teaching general mathematics by a traditional method with those of teaching general mathematics by an experimental method in which worksheets were employed. The initial ability levels of the pupils and the time devoted to the methods were considered in these comparisons.

##### Methodology

The investigation was conducted in four tenth-year general mathematics classes at a New York City vocational high school during the Fall 1959 term. Two experienced teachers, one a regularly licensed mathematics teacher and one teaching mathematics out of license, each taught one experimental and one control class. The four classes each contained 27 pupils matched by I.Q. and initial achievement in general mathematics. The four classes were equated by three levels of initial ability and by classes as wholes; pooled experimental groups were equated to corresponding pooled control groups. In the experimental classes worksheets were distributed to the pupils daily or every other day. These were mimeographed sheets which incorporated the elements of a traditional lesson. The pupils did not copy important facts into notebooks, and more time was available during the class period for exercises and problems. In the control classes parallel lessons were taught without the aid of worksheets, but using a recommended textbook. Less time was available for exercises and problems, but the

pupils wrote the aims and outcomes of the lesson in their notebooks.

Equivalent forms of a standardized general mathematics test were administered to the pupils at the beginning, middle and end of the term in order to ascertain each pupil's gain in achievement for the first half of the term, for the second half of the term, and for the term as a whole. As independent measures of medial and final achievement, a uniform mid-term examination and a uniform final examination in general mathematics were also administered. Nonparametric statistical methods were used to test the differences, if any, between the two groups.

##### Findings

Some of the major findings of this investigation were:

1. For the term as a whole, for the first half of the term, and for the second half of the term, there were no significant differences in achievement in general mathematics between the 54 pooled experimental pupils and the matched 54 pooled control group pupils. When these groups were considered by levels of initial ability, no significant differences were found between the pooled initially high, middle or low achieving experimental groups and the corresponding matched control groups.
2. The regularly licensed mathematics teacher's nine initially low achieving control pupils scored significantly higher on the mid-term and final examinations in general mathematics, and exhibited significantly greater gains in achievement for the second half of the term, than this same teacher's corresponding experimental group.

##### Conclusions

Some of the major conclusions of this study were:

1. There appeared to be no main difference between the experimental method of teaching general mathematics with the aid of worksheets and the traditional method, both with respect to levels of initial ability of the pupils, and with respect to the time devoted to the methods.
2. There was a tendency for the low ability pupils taught by a regularly licensed mathematics teacher to be more successful in general mathematics when taught by the traditional method than when taught by the experimental method.

##### Recommendations

Some of the recommendations suggested by this study were:

1. If, as this study seems to indicate, there is no difference between a worksheet method and a traditional method of teaching general mathematics, then since a more rigid control of some of the classroom variables is attained by using worksheets, perhaps this method should be employed in other controlled education experiments in which it is desirable to minimize extraneous variables.
2. An investigation might be undertaken to determine the most effective ways of teaching general mathematics to slow learners.

Microfilm \$3.65; Xerox \$12.85. 281 pages.



# STRUCTURE THEOREMS FOR A CLASS OF LATTICE-ORDERED REAL BANACH ALGEBRAS

(L. C. Card No. Mic 60-4243)

Ronald Albert McHaffey, Ph.D.  
Rutgers University, 1960

Major Professor: K. G. Wolfson

This thesis entitled as above represents a generalization of the work of Warren Ambrose and E. R. Keown. Ambrose considered Banach algebras with an involution whose underlying spaces were also Hilbert spaces; and was able to show this type of algebra to be isometric and isomorphic to a direct sum of full algebras of matrices over the complex numbers. A matrix is normed by the square root of the sum of squares of the absolute values of its elements.

E. R. Keown considered the commutative case for Banach algebras and an otherwise weaker system of axioms was able to obtain an abstract description for algebras of sequences of complex numbers, normed by the  $p$ th root of the sum of the  $p$ th powers of the absolute values of the elements multiplied by positive constants,  $1 < p < \infty$ .

The generalization of their work is as follows: An abstract representation is obtained for the completion of a direct sum of matrix algebras of possibly infinite dimension with elements from the real field, and normed by the  $P$ -norm mentioned above,  $1 \leq p \leq \infty$ . For  $p > 2$  the completion may or may not be Banach depending on the magnitudes of the positive constants. Examples are included in the thesis illustrating the possibilities.

The abstract representation of such an algebra is as follows: A lattice-ordered real semi-simple Banach algebra with an involution and satisfying Bohnenblust's condition  $P$  and further requirements on the maximal ideals and existence of positive elements is lattice isomorphic and isometric with involution preserved to the completion of the direct sum of matrices as indicated above. The ordinary transpose serves as involution. For the ordering a matrix is positive if and only if all its elements are positive or zero. A direct sum of matrices is positive if and only if all the matrices involved are positive.

The representation is developed by obtaining a maximal class of self adjoint mutually orthogonal idempotents in the algebra. These are obtained from the annihilators of certain of the maximal ideals of the lattice ordered algebra mentioned in the preceding paragraph. It is then shown that these idempotents are positive and that they serve to generate the algebra. The idempotents in each two sided minimal closed ideal serve to generate it. These minimal ideals are shown to be lattice-isomorphic to matrix algebras of the type mentioned above. Finally the whole algebra is shown to have a representation as the completion of the direct sum of the matrix algebras.

The converse to the representation theorem is given for  $1 \leq p \leq 2$ , and a discussion given for the complex situation arising for  $p > 2$ . The situation in the case of an annihilator algebra is discussed.

In the commutative case for a complex Banach algebra extensions of Keown's results are given; consider a commutative semi-simple annihilator algebra with the norm condition: if  $A = I_1 + I_2$ , a direct sum of ideals, and if  $x_i = y_i + z_i$ ,  $y_i$  in  $I_1$ ,  $z_i$  in  $I_2$  for  $i = 1, 2$ , then  $\|y_i\| =$

$\|y_2\|$  and  $\|z_1\| = \|z_2\|$  implies  $\|x_1\| = \|x_2\|$ . This algebra is isomorphic and isometric to a finite or infinite sequence algebra of the type mentioned earlier with  $1 \leq p \leq \infty$ . Microfilm \$2.50; Xerox \$4.00. 75 pages.

# THE GENERALIZED INVERSE IN LINEAR PROGRAMMING

(L. C. Card No. Mic 60-4204)

Leonard Duane Pyle, Ph.D.  
Purdue University, 1960

Major Professor: Carl F. Kossack

Results pointed out by A. Charnes pertaining to what R. Penrose has named the generalized inverse,  $A^+$ , of a matrix,  $A$ , together with certain well-known properties from matrix theory are utilized throughout. A brief summary of the research is as follows:

- (1) The equivalence of the equalities form of the linear programming problem and a derived linear programming problem formulated in terms of the eigenvectors of  $I - A^+A$  is demonstrated.
- (2) A characterization of duality in terms of orthogonality is given.
- (3) A necessary and sufficient condition for optimality is given in terms of the eigenvectors of  $I - A^+A$ .
- (4) The form of  $Q^+$  and the eigenvectors of  $I - Q^+Q$  is displayed where  $Q = [B, I]$ , and  $B$  is arbitrary. The form of  $Q^+$ , here, is essentially a result due to Penrose.
- (5) A necessary and sufficient condition that  $U^+ = U^*$  is given.
- (6) Edges and extreme points of the convex set of feasible solutions to the equalities form of the linear programming problem are characterized in terms of certain eigenvectors of projection matrices. It is shown that these edges and extreme points may be calculated using the Power Method.
- (7) The Simplex Method is applied to the special structure obtained using the generalized inverse.
- (8) An application of the eigenvector formulation in improving the condition of certain ill-conditioned matrices is given.
- (9) Results due to J. B. Rosen, who has developed the Gradient Projection Method, are utilized in developing a constructive method, called an interior gradient projection method, for solving linear programming problems using the generalized inverse of a matrix. A sequence of points is determined proceeding initially from a boundary point into the interior of the convex set of feasible solutions in such a manner as to hold invariant the value of the linear function which is to be maximized. From an interior point the method proceeds in the direction of the gradient projected on

the set of solutions, thus increasing the linear function. The sequence determined is shown to converge, in function value, to the desired maximum.

- (10) Computational experience on the Datatron digital computer is described using an interior gradient projection method as specialized to the Transportation Problem.

The major portion of the material summarized was first presented in a May 1958 Preliminary Report issued by Purdue University, Statistical and Computing Laboratory, prepared under Air Force Contract No. AF 41 (675)-160. Currently the research is partially supported by the Purdue Computer Research Program. A paper summarizing the research was presented at the RAND Conference on Mathematical Programming in March 1959. An abstract is being published by the RAND Corporation.

Microfilm \$2.50; Xerox \$6.40. 131 pages.

# A STUDY OF MATHEMATICAL MODELS OF EPIDEMIC DISEASE DISTRIBUTIONS

(L. C. Card No. Mic 60-4207)

Verne Gilbert Robinson, Ph.D.  
Purdue University, 1960

Major Professor: Carl F. Kossack

With brief allusions to history of epidemics and of epidemiology from the earliest times and to the status of the world today as regards communicable disease, this dissertation, based on a direct study of the rather extensive literature of mathematical epidemiology, traces the chronological development of mathematical models of epidemics from their beginnings in about 1840 to the present day.

A dozen models of various types from William Farr's apparently unwitting application of the normal distribution curve to epidemic morbidity reports to Norman Bailey's recent and potentially useful stochastic studies are discussed in detail. In each case special attention is devoted to the mathematical principles on which the particular model is based and -- insofar as is apparent -- to the biological principles underlying the mathematics. Notation is also made of other supporting pertinencies.

Current practices of morbidity reporting in the United States are set forth, and the imperfections of the system are pointed out. Possible avenues of improvement are suggested, and the role of modern statistics, both actual and potential, is emphasized.

The Theory of Competing Risks of Professor Jerzy Neyman of the University of California is modified and extended to a possible explanation for the development of an epidemic. While clearly in Newman's debt, the model results from essential redefinitions and weaker restrictions than those employed by him, and it thus represents a significant extension of his concept. A sample, "academic" epidemic is calculated, and a special table to assist other computations is included.

A representative bibliography of mathematical epidemiology and ancillary topics is contributed, and a concluding

chapter recapitulates the history of mathematical models by "idea" grouping, summarizes the work and notes possible lines of further study.

Microfilm \$4.30; Xerox \$15.10. 333 pages.

# EXISTENCE OF BOUNDED LENGTH CONFIDENCE INTERVALS

(L. C. Card No. Mic 60-3996)

Rajinder Singh, Ph.D.  
University of Illinois, 1960

Consider  $(\Omega, \mathcal{A}, \mathcal{P})$  where  $\mathcal{P}$  is a family of probability measures on  $\mathcal{A}$ , a  $\sigma$ -field of subsets of the set  $\Omega$ . Let  $X_1, X_2, \dots$  be random vectors defined on  $\Omega$  such that for each  $P$  in  $\mathcal{P}$ ,  $X_1, X_2, \dots$  are independent and identically distributed. Let  $h$  be a real-valued function on  $\mathcal{P}$ . In this paper the existence of bounded length confidence intervals for such functions is investigated. The decision theoretic setting is more thoroughly described in section 1. Also the various terms used in this abstract are defined in section 1 or in later sections.

Let  $d^1$  be a distance function on  $\mathcal{P} \times \mathcal{P}$  defined by

$$d^1(P, Q) = \sup |P(X_1 \in B) - Q(X_1 \in B)|$$

where the supremum is taken over all Borel subsets of the appropriate Euclidean space.

Suppose  $H_m[H_\infty]$  is the class of all  $h$  such that  $h \in H_m[H_\infty]$  if and only if  $h$  is a function from  $\mathcal{P}$  into the real numbers such that if  $L > 0$ ,  $\alpha > 0$ , there exists a random variable  $Y$  based on a  $m$ -stage [sequential] sampling plan such that

$$P(|Y - h(P)| \leq \frac{L}{2}) \geq 1 - \alpha, \quad P \in \mathcal{P},$$

$m = 1, 2, \dots$

It is shown in section 3 that if  $h \in H_1$  then  $h$  is uniformly continuous on  $(\mathcal{P}, d^1)$  and if  $h \in H_\infty$ , then  $h$  is continuous on  $(\mathcal{P}, d^1)$ .

For each  $m = 1, 2, \dots, \infty$ , denote the class  $H_m$  by  $H_m^0$  if the sampling plans are non-randomized. Various properties of the classes  $H_1^0, H_2^0, \dots$  and  $H_\infty^0$  are derived in section 4. For example, let  $g$  be a continuous real-valued function on the real line. By theorem 4.5, if  $h$  is in  $H_m^0$ , then the composite function  $g(h)$  is in  $H_{2m}^0$ ,  $m = 1, 2, \dots, \infty$ . In section 5, a few applications of the theorems in section 3 are given.

Section 6, though not directly connected with the main problem, deals with the existence of unbiased estimates. It is shown here that if  $\mathcal{P} = \{P_\theta \mid \theta \in \Theta\}$ , a real number interval and if the identity function on  $\Theta$  has an unbiased estimate based on a non-randomized one-stage sampling plan, then any limit of continuous functions of  $\theta$ , that is, any function in Baire class 0 or 1 has an unbiased estimate based on a randomized one-stage sampling plan.

Microfilm \$2.50; Xerox \$3.00. 45 pages.



THE ARABIC-LATIN TRADITION OF EUCLID'S  
ELEMENTS IN THE TWELFTH CENTURY

(L. C. Card No. Mic 60-3277)

Sister Mary St. Martin Van Ryzin, O.S.F., Ph.D.  
The University of Wisconsin, 1960

Supervisor: Professor Marshall Clagett

The purpose of this study was to evaluate and compare the twelfth century Latin versions of Euclid's Elements of Geometry translated from the Arabic by Adelard of Bath, Hermann of Carinthia, and Gerard of Cremona. The investigation was based primarily on five diverse texts of Book I of the Elements edited from manuscripts dating from the twelfth to the fifteenth century. Wherever feasible, an additional comparison was made between these texts and the Heiberg Greek edition of the Elements.

In order to orientate the reader as to the proper place of these medieval Latin versions in the history of the transmission of the Elements, a survey of the various editions, recensions, and translations of the Elements from their inception to the twelfth century, is presented in Chapter I. Chapter II discusses the Adelard, Hermann, and Gerard translations as to their general characteristics, the Arabic text on which they were based, and their interdependence on one another. Chapter III states the findings of the comparative analysis made of the introductions, geometric definitions, postulates, axioms, and propositions of Book I of the Elements. The second half of this thesis consists of the Latin texts of Book I of five different versions: the three ascribed to Adelard of Bath (designated respectively as Adelard I, II, and III), the version by Hermann of Carinthia, and that by Gerard of Cremona. The final chapter is a part by part commentary and comparison of these texts with one another and with the Greek text.

This investigation has led to the following results and conclusions with respect to the general characteristics and inter-relationships of the twelfth century Latin versions of the Elements:

(1) The Adelard I version represents an accurate rendering of some form of the al-Ḥajjāj Arabic version of the Elements. The proofs of the propositions in this version are formal, complete, and not unlike the Greek text.

(2) Version II of Adelard, another translation based on the al-Ḥajjāj version, constitutes an abridgment of the Elements in which brief directions for carrying out the argument are substituted for formal proofs. This version became the most popular in the medieval schools and the skeleton around which later commentaries were constructed.

(3) Version III ascribed to Adelard must now be conceded to be the work of an anonymous author of the late twelfth or early thirteenth century. It is not a translation from the Arabic, but rather an early Latin commentary on the Elements. The definitions, postulates, axioms, and enunciations of the propositions are those of Adelard II; the proofs, however, appear to be a paraphrasing of another text. The additional material contained in this commentary indicates that sources other than Euclid's work were used in its construction.

(4) The version ascribed to Hermann of Carinthia appears to stem from the same basic al-Ḥajjāj version.

Similarities in the wording of the definitions, postulates, axioms, and enunciations suggest some affinity with Adelard II; however, it is undoubtedly a new translation, for it is replete with Arabicisms not found in the Adelard versions. Some of the proofs are formal and complete, while others are more in the nature of a short commentary on the proof.

(5) The Gerard version is a careful and literal translation of an Arabic text based on the Ishāq-Thābit version of the Elements. It appears to have been made independently of the other Latin versions and is by far the closest to the Greek text.

This thesis provides a further understanding of the nature, availability, and authenticity of the medieval Latin versions of the Elements.

Microfilm \$6.05; Xerox \$21.60. 476 pages.

SEQUENTIAL ESTIMATION OF  
A BINOMIAL PARAMETER

(L. C. Card No. Mic 60-4014)

Madanial Tilakchand Wasan, Ph.D.  
University of Illinois, 1960

Let  $X = x_1, x_2, \dots$ , be a sequence of independent random variables, each with the same family of possible probability functions

$$P(X_{i=1}) = p, P(X_{i=0}) = 1 - p \quad 0 < p < 1.$$

A non-randomized sequential procedure for estimating  $p$  consists of a stopping rule and a rule for what to estimate.  $X_1, X_2, X_k = x_1, x_2, x_k$  having been observed, the rule must say, for every possible  $k$ ,  $x_1, x_2, x_k$  whether to (a) observe  $X_{k+1}$  or (b) stop and estimate  $z(x_1, \dots, x_k)$ . For a given estimation procedure  $\delta$ , let  $n_\delta(x_1, x_2, \dots)$  be the number of observations and  $z_\delta(x_1, x_2, x_{n_\delta})$  the value of the estimate when  $X_1, X_2, \dots = x_1, x_2, \dots$  are observed. Let  $N_\delta = n_\delta(X_1, X_2, \dots)$  and  $Z_\delta = z(X_1, \dots, X_{N_\delta})$ . Consider the two loss functions

$W_1(\delta, X) = N_\delta$ , the number of observations taken,

$W_2(\delta, X) = (Z_\delta - p)^2$ , the squared error of estimate.

The following three kinds of problems on choice of  $\delta$  can be considered.

A. Bounded expected sample size

Subject to  $E_p N_\delta \leq m$  and  $E_p Z_\delta = p$ ,

choose  $\delta$  to minimize  $E_p(Z - p)^2$

B. Bounded expected squared error

Subject to  $E_p(Z - p)^2 \leq a$  and  $E_p Z_\delta = p$

Choose  $\delta$  to minimize  $E_p(Z_\delta - p)^2$

C. Single loss function  $C_1 W_1 + W_2$

Subject to  $E_p Z_\delta = p$  choose  $\delta$  to minimize

$C E_p N_\delta + E_p(Z_\delta - p)^2$ .

In each case the minimization is to be done uniformly in  $p$  if possible, otherwise the supremum over  $p$  of the expected loss in question is to be minimized.

With choice of  $\delta$  restricted by the condition  $EZ_\delta = p$ , Wolfowitz showed for problem A that the fixed sample size  $m$  procedure has uniformly minimum variance. For problem B and C, Wolfowitz's method shows that fixed sample size procedures are minimax and admissible but do not uniformly minimize the risks involved. Problems B and C are discussed asymptotically as  $a \rightarrow 0$  and  $c \rightarrow 0$ . It is

shown that fixed sample size procedures are asymptotically inadmissible, preferable procedures are obtained, and asymptotically minimum risk procedures are conjectured. A similar discussion is given for problem B with the modification that the expected sample size risk is replaced by regret.

Microfilm \$2.50; Xerox \$3.00. 41 pages.

## MINERALOGY

## STRUCTURAL ASPECTS OF SOME MONTMORILLONITE-ORGANIC REACTIONS

(L. C. Card No. Mic 60-4003)

Rodney Tampa Tettenhorst, Ph.D.  
University of Illinois, 1960

The complexes formed by the reaction of a group of montmorillonites with a series of polyalcohol molecules have been studied by X-ray spacing measurements and infrared absorption spectra. The results have shown that, in certain instances, expandable clay minerals within the montmorillonite group may actually be differentiated on the basis of their basal spacings after they have been complexed with one or more polyalcohols. Complexes with polyalcohols which have a non-polar  $\text{CH}_2$  group exhibit relatively higher spacings with montmorillonites that possess a low layer charge and also when higher valence cations are in interlayer positions. Complexes with polyalcohols which do not possess non-polar  $\text{CH}_2$  groups exhibit similar spacings regardless of the nature of the montmorillonite or the interlayer cation. A lower initial

water content of the clay generally results in higher spacings for the montmorillonite-organic complexes with polyalcohols which have non-polar  $\text{CH}_2$  groups. Spacings are generally lower for complexes as more water molecules replace the organic molecules in the complexes and it is suggested that water molecules are often an essential component in montmorillonite-polyalcohol complexes. Higher spacings were observed for complexes with polyalcohol molecules which have OH groups in the middle of the chain compared to those which have OH groups on the ends of the chain and lower spacings were observed as the number of non-polar  $\text{CH}_2$  groups increased. A high OH/C ratio promotes lower spacings than expected while the presence of non-polar  $\text{CH}_2$  groups promote higher spacings than expected.

The polyalcohol molecules are bound to the basal oxygens of the clay surface through a weak  $\text{C-H} \dots \text{O}$  bond and little shortening of this bond distance was observed. The  $\text{C-H} \dots \text{O}$  bond strength is enhanced by the presence of higher valence interlayer cations.

Microfilm \$2.50; Xerox \$7.20. 153 pages.

## MUSIC

## THE MASSES OF CLAUDIN DE SERMISY

(L. C. Card No. Mic 60-3432)

Gaston Georges Allaire, Ph.D.  
Boston University Graduate School, 1960

Major Professor: Karl J. Geiringer

Choirmaster to Francis I, Claudin de Sermisy (c. 1490-1562) is the most representative Parisian composer of the early French sixteenth century. His works include over 200 polyphonic French chansons, over 50 motets, psalms, sequences, at least one Lamentation, one Passion and thirteen Masses. Many of his polyphonic chansons and motets were used in parody Masses by other composers of the Renaissance, and the music of his polyphonic chanson *Il me suffit de tous mes maux* has come down to us under the form of the Protestant chorale *Was mein Gott will* which J. S. Bach harmonized in his St. Matthew Passion.

In his Masses Claudin helped to develop the characteristic French terse style of the Renaissance chanson-Mass, and in studying them we find a gradually increasing influence from the polyphonic French chanson. He borrows from the chanson not only the homophonic style, the unmelodic bass that moves from root to root, and a pseudo-contrapuntal style, but also the *formes fixes* of the chanson, and especially the rhythmic patterns. Of the latter, the dactylic trade-mark of the polyphonic chanson ♩ ♩ ♩ can be found in all of Claudin's Masses. Claudin contributed to the simplification and the shortening of the polyphonic Mass, and also to the development of a characteristic French chanson-Mass. Of the thirteen Masses he wrote, at least, eight are parodies on motets, one is a parody on a chanson, and another is a parody on a canzona; two are plainsong Masses; two are freely composed works; and one is a paraphrase Mass.

Claudin's earliest Mass appears to be *Missa Novem*



lectionum which attests to his being grounded in the techniques of the Flemish school. However, all his other Masses are more French than Netherlandish, and they fall into three groups that give a clue to the evolution of his style. Missa Philomena praevia and Missa Domine quis habitabit are written in the best contrapuntal tradition of the late fifteenth to early sixteenth century in which a good balance is kept between the passages in imitation and in homophony, and generally the bass part is melodic. In a later category of Claudin's French Masses we find works that are much shorter, and use numerous short points of imitation, as well as a syllabic chordal style: Missa Plurium motetorum, Missa Requiem, Missa Domini est terra, Missa Tota pulchra es, and Missa Ad placitum. Finally the last group of Masses: Ab initio, Quare fremuerunt gentes, Voulant honneur, and Plurium modulorum, are characterized by more chordal passages than found in earlier Masses, and especially by a "lattice-work" texture of pseudo-imitative counterpoint of a more or less chordal effect.

Harmonically Claudin's style is simple, and his use of the dissonance is mild. He prefers smoothly flowing melodies to the thick texture of his contemporaries of Netherlandish inspiration, and to the contrapuntal intricacies of his predecessors.

Claudin seems to have especially favored a certain melodic pattern of an opening minor third moving toward an upper sixth. It is also interesting to note that another melodic pattern opening with an ascending minor third but soon moving down to the leading tone is found in works by Claudin, Antoine Févin, Gascongne, and Josquin des Prés. This last melodic pattern may possibly be a characteristic feature of the Parisian school of the early sixteenth century.

Claudin's music has remained dormant for three centuries although its value was recognized during his own lifetime, as is attested by the numerous sixteenth-century manuscripts, prints, reprints, parodies and arrangements found. It is hoped that the twentieth century will rediscover this music and give it the place it deserves in the repertoire of our churches, chapels, choral societies, concert halls, and recording rooms.

The modern transcriptions of the music of the Masses of Claudin included in the first Appendix of the dissertation presented here, was done in the 1:2 ratio ( $\diamond = \text{J}$ ). Accidental signs were added according to the instructions for solmization contained in Maximilian Guillaud's Rudiments de Musique pratique published in Paris by Nicolas du Chemin in 1554. The placement of the Latin text under the notes was done according to good Latin accentuation, melodic phraseology, and the sixteenth-century rules formulated by Zarlino.

Microfilm \$12.05; Xerox \$43.00. 955 pages.

VOLUME I: THE RITORNELLO PRINCIPLE  
IN THE ORGAN WORKS OF BACH.  
VOLUME II: APPENDIX.

(L. C. Card No. Mic 60-4749)

Henry John Eickhoff, Ph.D.  
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This study is concerned with Bach's adaptation of the ritornello principle of the concerto and aria to his works for organ. As a preliminary to the investigation of a specific formal procedure, Chapter I briefly surveys the general principles of musical form. Since the ritornello principle was originally employed during the last part of the Baroque period in music using tutti-solo contrast, Chapter II describes this principle on the basis of its treatment in selected arias and concerto movements from that period.

The ritornello itself is a complete musical idea to be played at the beginning of a movement by the full instrumental ensemble called for in the movement. Details of its construction may vary, but the incisiveness of its thematic ideas and its closed form are basic. The inherent logic of the ritornello principle derives from the returns of the opening musical "paragraph" at various points throughout a movement. In these returns the ritornello is usually varied in several ways: well-defined sections of the ritornello may return individually, various types of development may be applied to ritornello ideas, and usually a well-organized scheme of related tonalities is employed. Thus, whereas unity inheres in the idea of return, the potentialities for considerable expansion lie in the varied treatment of the returns.

A necessary corollary of the return idea in the logic of the ritornello principle is the idea of departure or contrast. This is realized in the solo sections or episodes, whose function is to provide contrast to the ritornello, although such contrast does not usually exclude subtle integration of ritornello and episode materials.

Chapter III considers the ensemble works Bach transcribed for the organ--several concertos by other composers, six chorale arias from his own cantatas, and one of his own trio-sonata movements. Not only do these transcriptions show the applicability of various types of ritornello-solo contrast to the organ but also they demonstrate the usefulness of the ritornello principle in works employing a chorale cantus firmus and in movements maintaining a continuous trio texture.

A survey of Bach's originally composed organ works reveals that he did indeed employ the ritornello procedure in many of them. Chapters IV-VI of the study analyze in detail the ritornello treatment in all the works constructed according to this principle--twelve trio-sonata movements, nine toccatas and preludes, several fugues, and thirty-one organ chorales.

Several related conclusions emerge from the details of these analytical chapters. First, the elementary logic of the ritornello principle remains fixed. When applied to types having specific characteristics deeply rooted in tradition, however, the principle adapts itself to and absorbs elements of the tradition. As a result essentially new types are created--the concerto-tocatta and -prelude, the concerto-fugue, the concerto-sonata movement, and the concerto-chorale. Second, although the original tutti-solo idea of the ritornello principle is fully exploited in

these organ works, perhaps the chief appeal of the ritornello principle to Bach lay in the possibilities it offered for integrating in a coherent framework as many contrasting musical ideas as he wished to introduce and for expanding those ideas at whatever length his artistic discretion dictated.

Microfilm \$6.65; Xerox \$23.65. 524 pages.

**TWO MANUSCRIPTS OF INSTRUMENTAL  
ENSEMBLE MUSIC FROM  
THE ELIZABETHAN PERIOD.**

(British Museum Add. MS. 31390 and  
Bodleian Library MSS. D. 212-216).  
[Including Volume II, Appendix].

(L. C. Card No. Mic 60-3463)

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Major Professor: Karl Geiringer

The purpose of this study was to examine the development of Elizabethan consort music from its vocal origin as presented in two manuscripts from the period. The following conditions governed the selection of the manuscripts: (1) they should contain a representative number of composers from the period; (2) they should picture, as clearly as possible, the evolution of Elizabethan instrumental ensemble music; and (3) they should contain a sufficient number of works in one instrumental form so that a valid analysis of that form could be concluded. The two manuscripts chosen on the basis of the forementioned conditions were British Museum Additional Manuscript 31,390 and Bodleian Library Manuscripts D. 212-216. Together they contained almost two hundred vocal and instrumental compositions by both Continental and English composers from the sixteenth and early seventeenth centuries. Approximately half the contents of the two sources were In Nomines, an English instrumental form based on a cantus firmus from the Benedictus of Taverner's "Missa Gloria tibi Trinitas."

The major portion of the study was concerned with the analysis of compositions from the two manuscripts. Particularly emphasized were: (1) the development of a characteristic instrumental style; (2) formal features, including musical unifying devices, texture, and contrapuntal idiom; (3) melodic characteristics; (4) the vertical interval technique, including consonance, dissonance, and the use of modes; (5) "Musica Ficta," notational features, and problems of transcription.

**Findings and Implications.** Although instrumental music was, no doubt, practiced prior to the sixteenth century, instrumental consort music, as an independent art medium, was largely the creation of the Elizabethan Period. During the second half of the sixteenth century, English instrumentalists were quite famous, and in the seventeenth century, they were favored by some Continental courts.

The level of Elizabethan achievements in instrumental art, particularly consort music, cannot be judged by printed collections from the period since the great mass of instrumental compositions survives in manuscripts.

Although many of the sources, entitled "apt for voices or viols," include vocal works, a large number of distinctly instrumental compositions are also in evidence.

The most ambitious efforts at instrumental composition, during the sixteenth century, were centered in the In Nomine. The earliest In Nomines were identical to the English vocal cantus firmus motet of the period. The long-note cantus firmus was sounded in the same voice throughout the work and rarely entered the polyphonic movement of the remaining parts. The form consisted of a succession of themes, treated in fugal imitation.

By utilizing a well-established form, the English were able to develop an outstanding and, in many respects, a unique instrumental style. They carried vocal features into the In Nomine which were based on an amazing amount of melodic and harmonic freedom. Minor second dissonances, vertical tritones, and other equally striking harmonic combinations were characteristic of the form.

As instrumental technique developed, the In Nomine left the confines of its vocal origin, and in the third quarter of the century, composers employed a distinctly instrumental style. In the late Elizabethan period, instrumental technique developed enormously, and the form became marked with elaborately ornamented figures. Theme differentiation became the most distinctive formal device.

The In Nomine is historically important, because it was the principal form during the English instrumental art medium's infancy and because it provided the foundation for future development. Although the cantus firmus technique connected it to the past, the more adept composers were able to draw from it much more than its historical position might indicate. Some of the works by Christopher Tye, Robert Parsons, William Byrd, Alfonso Ferrabosco II, and Orlando Gibbons attain an amazingly high level of excellence and deserve performance today.

Microfilm \$6.70; Xerox \$23.65. 525 pages.

**MUSIC EXPERIENCES PROVIDED FOR PUPILS  
IN THE TENTH, ELEVENTH, AND TWELFTH  
GRADES OF THE PUBLIC SECONDARY SCHOOLS  
OF PENNSYLVANIA, 1959-60.**

(L. C. Card No. Mic 60-3774)

Richard Grim Neubert, Ed.D.  
New York University, 1960

Supervisor: Professor Luther W. Goodhart

This study describes the present practices related to music experiences for pupils in the tenth, eleventh, and twelfth grades in the public secondary schools of Pennsylvania and examines the need for the revision of the Course of Study in Music Education for these grades as organized for the Department of Public Instruction. M. Claude Rosenberry, Chairman of the Committee responsible for the preparation of this document in 1933, indicated the need for a survey of current conditions in the senior high schools of the Commonwealth.

Statements by leading educators and authoritative committees are examined relative to the significance of music education within the theory and practice of general education. Intrinsic to the study is the concern for a



balanced program of courses and activities which provides a variety of desirable music experiences for all students in the tenth, eleventh, and twelfth grades. The data related to music courses, activities, and related administrative provisions were secured through an analysis of the related literature. To test the validity of these data a questionnaire was sent to a jury of sixteen experienced music educators in Pennsylvania. Items considered valuable by the jurors were included in a second questionnaire sent to a sampling of 255 public secondary schools categorized in five size groups. This questionnaire sought evidence of school provisions for pupils' music experiences and opinions regarding the desirability of items considered valuable by the jury for inclusion in a revised State music guide.

Approximately one-third of the pupils were reported enrolled in music courses. Twenty per cent of the schools indicated that music credits were not included in the total number of credit units required for graduation. The smaller schools were noted to provide the least number of courses, but to provide for the largest percentage of pupils. An inverse ratio was noted for the larger schools.

Band experiences were reported by more than 90 per cent of the schools, orchestral experiences by 25 per cent. Mixed chorus activity was indicated by 83.4 per cent. Only a minority provided courses such as General Music and Music Theory. A wide variance in opinion was evident in the credit interpretation for music. Music events reported most frequently included concerts, festivals, graduation exercises, and civic events; operettas and cantatas with significantly less frequency. More than one-third of the respondents reported that assembly singing was not provided on a scheduled basis. The correlation of music with other subjects was indicated by a minority of the schools. Only 7.7 per cent indicated curriculums for the music major.

Conclusions derived from this survey are: that the balanced program of music courses and activities considered desirable is generally not provided for the majority of pupils; that pupils are not afforded sufficient opportunities for assembly singing; that only a minority have opportunity to elect music courses; that orchestral experiences are seldom provided; that music is not properly credited by many schools; that there is insufficient provision for pupils with special interests in music; and that small high schools provide a restricted program of musical activities.

Recommendations for a revised State music guide are based on agreements in opinion by the jury and a majority of responding educators and the findings of this study. All courses and administrative provisions considered valuable by the jury are viewed as desirable for discussion in the music guide. Related aspects of the music program recommended for inclusion in a revised State music guide include general and specific aims; teaching procedures and materials; evaluative criteria; regulations pertaining to credit; minimum course requirements for the music major and minor; and suggestions related to scheduling and class size.

Microfilm \$4.50; Xerox \$15.75. 350 pages.

## ENVIRONMENTAL SOURCES OF MUSICAL AWAKENING IN PRE-SCHOOL CHILDREN

(L. C. Card No. Mic 60-3983)

George Earle Reynolds, Ed.D.  
University of Illinois, 1960

**The Problem** - This study investigated the relationship between factors in the home environment and awakened musicality at the kindergarten entrance and in addition, the effect of the organized musical experiences during one semester of kindergarten. Awakened musicality is defined as the ability to sing in a definite tonality with rhythmic and melodic delineation. The study was made to determine the validity of the hypothesis that there is a direct relationship between factors in a child's musical environment and his musical awakening or non-awakening.

**The Procedure** - To determine which children in the six kindergartens investigated were or were not musically awakened, a tape recording was made of each child at kindergarten entrance requesting him to sing any song he knew. A panel of five judges evaluated the recordings and rated the efforts of each child. By virtue of the averaged score for each child, he was placed in one of four groups, the upper two groups being considered musically awakened.

An interview of the parents of each child was conducted in the child's home. The factors of the home environments disclosed by each interview questionnaire were compiled into percentages and assigned to the group in which the child's rating placed him. Common identifiable factors found in significant percentages in any of the four groups were deemed to be pertinent to the hypothesis of the study. The same procedure was used to evaluate the musical experiences of the kindergarten children after one semester of organized musical experiences.

### Conclusions:

In answer to the specific questions raised by the study, the following conclusions were reached on the basis of the evidence gathered.

1. Eleven of eighty-five children were found to be musically awakened at kindergarten entrance.
2. Factors contributing to awakened musicality in pre-school children included:
  - a. Mothers who sang, played piano and helped operate the phonograph for the child
  - b. Parents who provided quality children's records for their children, took them to concerts and provided other listening opportunities and had themselves received some musical training
  - c. Parents who appreciated the aesthetic values inherent in music and were interested in aiding the child in musical growth
  - d. A permissive home atmosphere in which interested parents encouraged musical expression by the child
  - e. The importance of the role played by the mother in awakening the child's interest in music
  - f. The presence of a piano and phonograph in the home.

The environmental sources of musical awakening of pre-school children are: the exposure to attractive musical experiences in a permissive and encouraging atmosphere, and the importance of parental understanding and appreciation of the values of music in the life of their

child. In the absence of these the role of the kindergarten teacher in providing the initial musical experiences, in developing the cognizance of and growth in musical awareness, becomes increasingly important.

Microfilm \$2.50; Xerox \$5.60. 112 pages.

## PHARMACOLOGY

# POTENTIATION OF CATECHOL AMINES BY IPRONIAZID

(L. C. Card No. Mic 60-4738)

Joseph Leo Borowitz, Ph.D.  
Northwestern University, 1960

The central nervous system (CNS) stimulant effects of amphetamine are markedly potentiated by 1-isonicotinyl-2-isopropyl-hydrazine (iproniazid, IIH). It was thought that if epinephrine, which does not pass the blood brain barrier except to a limited extent in the area of the hypothalamus, could be induced to enter the brain, its CNS effect could also be potentiated by IIH. By administering epinephrine subcutaneously in divided doses, it was hoped that the prolonged elevated blood levels thus produced would favor the passage of epinephrine into the brain. Epinephrine, administered in this way to IIH treated and control rats, failed to produce a CNS stimulation in either group, but the incidence of cataract and subsequently mortality in the IIH treated group was markedly greater than in controls. This unexpected result was surprising in view of reports to the effect that IIH did not potentiate epinephrine, and led to an investigation of the mechanism involved.

The potentiation was also observed in mice, and with another drug, levarterenol, in rats. Single subcutaneous doses of the amines were found to be adequate in showing the toxicity difference. The lethargy, piloerection, and exophthalmos produced by the catechol amines were also enhanced by IIH pretreatment.

The toxicity of single intraperitoneal doses of levarterenol was not significantly potentiated by IIH in 4 of 5 experiments involving 90 rats. Multiple intraperitoneal doses of levarterenol, however, were more potent in IIH treated rats.

To rule out possible differences caused by breakdown of the amines in the subcutaneous and peritoneal depots, dl-arterenol was administered by jugular vein at a slow rate (1 mg/ml/85 minutes). The rats pretreated with IIH died after having received  $0.73 \pm 0.66$  mg; the controls after having received  $4.66 \pm 1.74$  mg ( $p < 0.01$ ). At a

faster rate of administration (1.5 mg/ml/85 minutes), the difference was not so great,  $0.84 \pm 0.44$  as opposed to  $2.0 \pm 1.33$  mg. but still was in the direction of potentiation. It seems that IIH potentiates the catechol amines best when they are given so that a relatively slow rate of absorption obtains.

Isoniazid, which is closely related to IIH chemically and pharmacologically except that it does not inhibit monamine oxidase (MO), does not, in doses up to 100 mg/kg. potentiate levarterenol given subcutaneously to rats. On the other hand, phenethylhydrazine, another MO inhibitor, does potentiate subcutaneously administered levarterenol in rats. At the conclusion of these experiments, it seemed that MO inhibition was the mechanism of the observed potentiation. It was later found, however, that alpha-methyl-levarterenol, a dihydroxyphenyl sympathomimetic amine which is not an MO substrate, is also potentiated by IIH.

To distinguish between potentiation by inhibition of breakdown of the amines, and potentiation by sensitization of the responding mechanism to the amines, tissue analyses for levarterenol were carried out after administration of IIH, levarterenol, and both drugs together. Levarterenol in rat brain and heart was extracted and estimated according to the method of Shore and Olin. IIH significantly increased the levarterenol content of brain and heart, whereas levarterenol administration significantly increased levarterenol in heart but not brain. The increase produced by both drugs together was not significantly greater than the sum of the increases produced by the drugs given individually. There is some indication that larger subcutaneous doses, of levarterenol, corresponding to those used to show the toxicity difference, may have shown interference in the metabolism of the administered amine by IIH.

According to the literature, IIH increases the levarterenol content of tissues, alters the urinary metabolites of epinephrine and levarterenol, cancels the ability of liver to inactivate epinephrine, and inhibits the destruction of labeled epinephrine perfused into dogs. This evidence indicates that IIH interferes with the metabolism of catechol amines, and may be related to the potentiation of these substances by IIH noted in this dissertation.

Microfilm \$2.50; Xerox \$4.60. 88 pages.



## PHILOSOPHY

### SIMPLICITY AND THE ACCEPTABILITY OF SCIENTIFIC THEORIES

(L. C. Card No. Mic 60-3405)

Robert John Ackermann, Ph.D.  
Michigan State University, 1960

Major Professor: Richard Kudner

This thesis is an examination of the frequent claim made by scientists and philosophers of science that one scientific hypothesis or theory is chosen over another because it possesses greater "simplicity." The purpose of the thesis is to ascertain whether any clear notion of simplicity is available for making such discriminations in a way compatible with apparent scientific practice.

Chapter one is a survey and discussion of the traditional accounts of the role claimed for "simplicity" in the literature. The familiar citation of simplicity as the crucial factor in the so-called Copernican revolution in astronomy is discussed, as well as the medieval methodological principle known commonly as Occam's Razor and more recent reworkings of the notion by Russell and Mach. It is concluded that none of these traditional notions is acceptable, largely on the grounds that they are either couched vaguely in odd psychological language, or where clear, replaceable by other notions already explicated by philosophers of science. Two modern, formal, seemingly objective notions, however, survive the historical survey.

The first of these is the notion of inductive simplicity. This view characterizes scientific activity as resulting in data points, through which the "smoothest" curve, representing the "simplest" hypothesis, is drawn by the scientist. Criteria for the unique "smoothest" curve or "simplest" hypothesis have been proposed by Harold Jeffreys, Karl Popper, and John G. Kemeny. Chapter two of the thesis examines these proposals, giving reasons why these proposals cannot select a unique curve where they are precise, and demonstrating that the proposals rest on severely restrictive implicit assumptions which would destroy their usefulness even if they were adequate under these assumptions. The chapter concludes by surmising that inductive simplicity fails due to an inaccurate picture of scientific experimentation; for the latter seems to be more generally concerned with theories that have been proposed as explanations of data prior to experiment, than with inducing empirical hypotheses from data points already gathered.

The other notion to survive the historical survey is the notion of the formal simplicity of scientific systems. Nelson Goodman has proposed an important calculus of simplicity which allows assignment of integers representing complexity-values to scientific systems formalized within the first order predicate calculus with identity. This assignment is based on the logical properties (symmetry, self-completeness, and reflexivity) of the extra-logical primitive terms in any such formalization. In effect, Goodman's system allows an ordering of scientific

systems appropriately formalized according to a precise and important notion of simplicity. Chapters three and four exposit Goodman's calculus, examine objections to it in the literature, and conclude that it appears to be an objective notion of simplicity which will square with the importance assigned to simplicity as a criterion for the acceptability of scientific hypotheses in the literature. Certain restrictions on its use are noted, however, as well as areas that need development for a full explication of scientific choice situations.

Microfilm \$4.35; Xerox \$15.30. 338 pages.

### SCIENCE AND LIBERAL ART

(L. C. Card No. Mic 60-4594)

Hugh Harris Caldwell, Ph.D.  
University of Virginia, 1960

Principles capable of harmonizing Platonic mathematical philosophy and Aristotelian hylomorphism are presented in this work. Empirically derived generic universals, or second intentions, are distinguished from mathematical universals, which are treated as relations and patterns of order rather than as quantities. Mathematical laws of nature are regarded as relational invariances or formal structures mapped into the data of experience using semantical correspondence rules. The free constructive role of the mind in pure and applied mathematics suggests that these are arts; their freedom from the limitations of tangible material suggests that they are liberal arts. Thus mathematics is restored to its role as a liberal art.

The concept of what a member of a species is cannot be freely constructed, however, since it must be identical with what the object actually is. This Aristotelian cognitive identity of mind and object is contrasted with the isomorphic truth relation of applied mathematics. The distinction made by John of St. Thomas between formal and instrumental signs is applied to the two types of universal. The relational structures of mathematics are instrumental signs, which, as in pure mathematics, can terminate cognition. The non-representing logical relations involved in the three basic Aristotelian operations of the intellect are interpreted as formal signs. Science is the name attributed to all forms of knowledge involving an identity of mind and object through the formal signs of a logic of intensions, while liberal art refers to a priori constructions in logic and mathematics. Aquinas also used the terms in this sense.

The materials of the liberal arts are relations having any number of terms. Aristotle's own characterization of relations as apprehensible only by the mind, as clear, distinct, and univocal in all applications, and as capable of existing independently in the mind, supports the thesis that mathematics deals with relations rather than quantities.

Also, the realization that mathematical patterns transcend all of the Aristotelian categories effectively refutes the Aristotelian view that relations can be reduced to accidents of a substance. The relations of mathematics are univocal transcendentals in contrast with *ens* and other analogical transcendentals. This approach sustains Plato's mathematical philosophy.

A chapter on the metaphysical foundations of mathematics attempts to show that pure mathematics can be reduced to relations postulationally imposed upon the Aristotelian-Thomistic transcendental concepts. The treatment of cardinal numbers as classes of transcendental concepts accounts for their exact and universal applicability and renders unnecessary Russell's assumption that a cardinal number must be the number of some class. Very general relations belonging to the foundations of mathematics and perceptual experience--diversity, equality, class, linear order, etc.--are treated as pure forms of the understanding. These "categories," however, do not exclude knowledge of things-in-themselves through second intentions.

The final chapter is an application of the science-liberal art distinction to cosmological problems. The spatio-temporal order of mathematical physics is contrasted with the Aristotelian hierarchical order of substances. Aristotle's errors of treating "place" and relations as accidents predicated of a substance are shown to have played a major role in the rise of mechanism. The general theory of relativity shows the untenability of regarding "proper place" as a fixed terminus for locomotion. A fundamental weakness in Aristotle's philosophy is removed by the realization that locomotion is merely a change in spatio-temporal relations. This, and the absence of forces and causes in Einstein's kinematical physics, leads to a resolution of the mechanism-teleology controversy. Also, problems involving causal connection and the existential neutrality of relational systems are illuminated by the distinction.

Microfilm \$3.20; Xerox \$11.25. 247 pages.

MARTIN HEIDEGGER: KANT AND  
THE PROBLEM OF METAPHYSICS,  
TRANSLATED WITH AN INTRODUCTION AND  
NOTES BY JAMES SPENCER CHURCHILL.

(L. C. Card No. Mic 60-2805)

James Spencer Churchill, Ph.D.  
Indiana University, 1960

This thesis is a translation of *Kant und das Problem der Metaphysik* by Martin Heidegger. Since the introduction and notes constitute my original contribution, the abstract is based upon these last.

Kant's principal contribution to philosophical thought may be summarized under the heading: the fundamental hypothesis of idealism. This hypothesis holds that objective experience cannot be accounted for by the elements of immediate experience and the ability of the mind to abstract and accumulate enduring principles of order from the relationships subsisting between these elements. On the contrary, according to this hypothesis what may be termed the "objectivity-factor" required must be *a priori*

and hence cannot have its source in the mind as ordinarily conceived but must be based upon some special, non-psychological concept of mind--in Kant's case, pure reason.

Once his often confusing terminology, e.g., "the Being of essents," is understood, an analysis of Heidegger's major work *Sein und Zeit* reveals that he accepts the fundamental hypothesis of idealism without question. Indeed, the object of *Sein und Zeit*, "the concrete elaboration of the question as to the meaning of Being," (*Sein und Zeit*, p. 1) is nothing other than an analysis of that which makes the above mentioned objectivity-factor (in Heidegger's terminology "the comprehension of Being") possible.

However, it is in *Kant and the Problem of Metaphysics* that Heidegger's position relative to idealism comes most clearly to light. This book, we find, falls naturally into two parts. The longer of these, under the guise of a "laying of the foundation of metaphysics," is a critique of Kant's analysis of pure reason as the source of the objectivity-factor in question. The shorter is concerned with a "repetition" of the laying of the foundation of metaphysics.

The burden of the first part of Heidegger's *Kant-book* (Sections One through Three) is that although the whole trend of the *Critique of Pure Reason* points to the central function of the transcendental imagination in so far as the possibility of the synthetic *a priori* is concerned, Kant because of his rationalistic bias refused to accept this conclusion and in the second edition sought to restore the supremacy of reason. One of the objects of Heidegger's endeavors in the *Kant-book* is through "violence" to wrest from Kant what he "intended to say" but because he was a prisoner of tradition "recoiled from," namely, that temporality as the ground of the transcendental imagination is the basis of the "selfhood" of the self--of pure practical reason as well as the other "faculties of the soul."

The second part of the *Kant-book* (Section Four), namely, that devoted to a "repetition" of the central problem of the *Critique of Pure Reason*, is not simply concerned with a restatement of this problem. Rather, in Heidegger's sense of the term, to repeat a problem is to disclose "the primordial possibilities concealed in it" (*Kant-book*, p. 274). According to Heidegger, the repetition of a problem both preserves the problem as a problem and at the same time in a kind of dialectical movement takes us beyond it. Thus, in *Sein und Zeit*, the essentials of which are presented in Section Four of the *Kant-book*, Heidegger goes beyond the problem of trying to account for the possibility of objective experience by means of the comprehension of the Being of things to the problem of Being as such and its relation to man.

The suggestion is made in the concluding paragraphs of the introduction that Heidegger's works written after *Sein und Zeit*, in particular, those published after World War II, represent a continuation of this dialectical movement, the ultimate end of which seems to be the emergence of Being as such as a kind of Absolute.

Microfilm \$4.65; Xerox \$16.45. 361 pages.



## CREATIVITY IN ART

(L. C. Card No. Mic 60-4761)

Carl Ransdell Hausman, Ph.D.  
Northwestern University, 1960

The problems concerning creativity in art are grouped under four basic questions: What happens in the creative process? What kind of person creates art? What motivates the artist? and How does the artist produce something new from something old? My chief purpose is to examine the way these questions have been answered by three interpretations of creativity. Special emphasis is given to the last question.

The first interpretation denies (by implication) genuine novelty in the "created" product. This approach is represented by the theories of experimental and psychoanalytic psychology and by the philosophical view of Neo-Thomism. The second interpretation does not deny genuine novelty, but accounts for it in terms of the principles of emergent evolution. The third approach, represented by Crocean idealism, insists that novelty is genuine, but sees it as inexplicable.

In the first chapter, which includes the experimental psychologists, the question, What occurs in the creative process? is treated at the outset. Four steps in the creative process which have been identified by most writers on the topic are analyzed. The answers psychologists have given to the other questions are then considered, and special attention is given to those psychologists who focus on the problem of finding psychological laws which account for creative activity. The Gestalt approach as represented by Wertheimer is compared with the methods employed by the other writers in order to evaluate the adequacy of the experimental approach to creative thinking.

The theory of Freud is taken as the basis for the psychoanalytic approach considered in the second chapter. However, the ways in which other psychoanalytic writers

develop or oppose Freud's theory are examined in relation to the psychoanalytic attempt to identify the mechanisms which make possible creative work. The non-Freudian views of Rank and Jung are given special attention in order to determine whether they account for the aesthetic as distinct from the non-aesthetic expression of unconscious drives.

In the third chapter, the theory of Maritain is selected to represent one aspect of Neo-Thomist aesthetics. Maritain's general conception of the nature of the work of art is related to his analysis of the creative process. Special attention is given to Maritain's view that art is symbolic and to the implications of this view for the possibility that the work of art possesses genuine novelty.

The ideas of Alexander, Whitehead, and Bergson are examined in the fourth chapter, which is devoted to the interpretation of creativity in the theories of emergent evolution. The way each writer describes the aesthetic as distinct from the non-aesthetic manifestation of creativity in nature is studied. And the ways each writer describes the emergence of aesthetic novelty are compared and evaluated.

In the fifth chapter, Croce and Collingwood are chosen to represent the idealist interpretation. The insistence of these writers on the autonomy of art is examined with reference to the question whether a rational account of creativity can be given.

In the last chapter, it is suggested that creativity in art cannot be fully understood until the nature of novelty or originality in the work of art has been clarified. Four senses of "novelty" are analyzed with regard to the kinds of value attributable to works of art. The sense of "novelty" which is essential to the interpretation of the work of art as an organic whole is then considered in respect to the possibility of subjecting creativity in art to rational analysis and to scientific explanation.

Microfilm \$4.90; Xerox \$17.35. 381 pages.

## PHYSICS

## PHYSICS, GENERAL

MECHANICAL PROPERTIES OF  
THIN SINGLE CRYSTAL GOLD FILMS

(L. C. Card No. Mic 60-4595)

Avery Catlin, Ph.D.  
University of Virginia, 1960

Thin single crystal gold films were grown by vacuum deposition on heated (375°C.) sodium chloride substrates. Completely oriented films with thicknesses between 1000 and 3000 Angstrom units were obtained, with the plane of the film being a (100) crystallographic plane. The mechanical properties were determined by stressing the films using a modified "bulge" technique. A small hole was drilled through the substrate with a water jet and both the pressure differential between the two sides of the film in the test area and the deflection of the film were meas-

ured. The films were observed to undergo considerable plastic deformation, with optically visible bands of mechanical twinning appearing as stress was increased. Both the ultimate tensile stress and the elastic modulus were found to increase as the thickness of the films was reduced.

Microfilm \$2.50; Xerox \$3.00. 42 pages.

SPECTRAL REFLECTANCE BY SOLIDS OF  
CARBON K RADIATION

(L. C. Card No. Mic 60-3844)

Ralph Frederick Wuerker, Ph.D.  
Stanford University, 1960

The absolute percentage of carbon K radiation reflected from plane surfaces of natural quartz, glass, and vacuum

metalized films of beryllium, carbon, aluminum, silver, and gold was experimentally measured as a function of the angle of grazing incidence. For each test the values of the optical constants, specifically the critical angle  $\theta_c$  and the absorption ratio  $Y$ , were determined by comparison with Fresnel theory. The experimental values of the critical angle were then compared with the predictions of theory; i.e., the theories of Lorentz, Kallman-Kramers-Mark, Hönl, and the recent generalized dispersion theory of L. G. Parratt.

The vacuum reflectometer used for measurements at 44.6 Angstroms was a modification of the unit originally developed by R. W. Hendrick for studies at 8.32 Angstroms. In the present apparatus, the incident x ray beam was defined by the combination of the carbonized wire anode of the source and either a Seeman slit or an intermediate screening slit which normalized the relative reflectance measurements made with the Seeman slit. The intensity of the reflected x ray beam was measured with an argon-ethyl alcohol Geiger-Müller detector having a 10 percent transmitting 0.00025-inch thick Mylar window. The dead time of the detector was determined by an external monostable multivibrator quenching circuit. Pulses from this circuit were recorded by an internally timed Model 521A Hewlett-Packard counter. A half-angle linkage coupled the reflector and detector carriages assuring that the reflected beam always impinged on a fixed portion of the counter window.

Microfilm \$3.05; Xerox \$10.60. 234 pages.

#### EXPERIMENTAL ANALYSIS OF MOLECULAR BEAMS AT HIGH SOURCE PRESSURES

(L. C. Card No. Mic 60-4638)

Ricardo Zapata-Nakin, Sc.D.  
University of Virginia, 1960

High intensity molecular beams are a useful tool for studying neutral molecular interactions with solid surfaces and other molecules. The use of a supersonic nozzle as molecular beam source was suggested by Kantrowitz and Grey in 1955. The simple theory proposed by them predicts final beam intensities which are much higher than those obtained from conventional sources. The experimental work reported here represents an attempt to realize the supersonic molecular beam in the laboratory. The analysis was carried out in two steps. The first step consisted of analyzing the beam performance from the point of view of the supersonic, isentropic Kantrowitz-Grey model. Very low efficiencies indicated that the idealized assumptions of the theory were not being realized in the actual experiments. Attenuating effects both upstream and downstream of the source orifice had to be expected because of the miniature scale of the supersonic components, the relatively high beam density and the relatively high pressures in the collimating chamber. The second step consisted of direct comparison of the performance of nozzle beams, with more conventional (oven) beams, produced by effusion through an orifice at the two extreme flow regimes: Low density conventional oven beams were used for calibration of the detector. Comparative analysis of hydrodynamic and nozzle beam perform-

ance and use of blunted skimmers lead to the conclusion that in most instances a bow compression shock stood in front of the source orifice (skimmer) thus dissipating completely the supersonic flow. Experiments showed that this decisive upstream effect could only be overcome by making the ratio of the radius of curvature of the skimmer lip to the skimmer aperture diameter extremely small. These experiments consisted of measurements of the total final beam intensity and of its angular distribution. Thus the presence of supersonic flow was detected. However, its Mach number could not be computed on the basis of mass flow measurements, as in the case of completely isentropic flow, because in the present case the flow was partially supersonic to an unknown extent. Velocity distribution measurements, to be performed in the near future, will tell about this supersonic flow in a quantitative way. Very interesting results were obtained with the oven type beam sources while studying the attenuating effects downstream of the source orifice. Background scattering and self scattering of the beam were found to be related to each other. Background absorption of the beam in the collimating chamber is a very significant effect, which makes it desirable to concentrate most efforts in this chamber pumping system when building a molecular beam apparatus. Self scattering, on the other hand, is inherent to the beam density. However, experimental results seem to indicate that the design of the source orifice can be optimized in order to minimize the over-all effect of the high density of the beam. As in the case of the supersonic beam study, experimental results obtained clearly indicate the direction to proceed in order to obtain optimum final results. Microfilm \$2.50; Xerox \$7.80. 168 pages.

#### PHYSICS, ELECTRONICS AND ELECTRICITY

##### MEASUREMENT OF THE INTERNAL FIELD IN A FERROMAGNET USING 3.4 MEV POLARIZED NEUTRONS

(L. C. Card No. Mic 60-4626)

Thomas Garnett Williamson, Ph.D.  
University of Virginia, 1960

The internal magnetic field in a ferromagnet was determined by measuring the change in the vertical component of polarization of a beam of polarized 3.4 Mev neutrons which had passed through magnetized iron. The beam of polarized neutrons was obtained from the  $D(d,n)He^3$  reaction using 1.0 Mev deuterons on a heavy ice target in a Van de Graaff accelerator. The polarization was found from the right-left asymmetry produced by scattering the beam from a carbon analyser. The ferromagnetic substance through which the beam was passed was a 6.7 cm thick piece of vanadium permendur (49% Fe, 49% Co, 2% Va) which was placed between the poles of an electromagnet. The magnetic flux density in the permendur was determined by standard ballistic galvanometric techniques and within experimental error agreed with that calculated from the depolarization produced. Thus, within experimental error, the field effective for



precessing the spins of fast neutrons is the magnetic flux density  $B$ . Microfilm \$2.50; Xerox \$3.60. 62 pages.

## PHYSICS, NUCLEAR

### ENERGY SPECTRUM OF PHOTONEUTRONS FROM GOLD

(L. C. Card No. Mic 60-4590)

Raymond Fike Askew, Ph.D.  
University of Virginia, 1960

The distribution in energy of the photoneutrons produced by the bombardment of gold with 55 Mev bremsstrahlung has been investigated. Ilford C-2 photographic emulsions, 200 microns in thickness, were used as detectors. About 3000 proton recoils were observed in one emulsion for all neutron energies above 1/2 Mev. A method of "fast" scanning was applied to two additional emulsions. This method consisted of accepting only those proton recoils which were caused by neutrons of energy  $\geq 4$  Mev. Over 800 recoils were observed by this scanning technique.

A new method has been developed for obtaining the corrections for tracks which originate but do not terminate within the emulsion. This method does not require the assumption that the incident neutron transfers all of its energy to the proton recoil.

The results of the experiment do not show a pronounced double peak in the energy spectrum. Assuming a level density of  $Ce^{(aE_R)^{1/2}}$  with  $a = 1.6(A-40)^{1/2}$ , it was found that at least 10-15% of the neutrons detected were of the resonance direct type described by Wilkinson. Curves are also given showing various percentages of the total yield as direct photoneutrons. In all of these a peak exists in the direct neutron spectrum at approximately  $5\frac{1}{2}$  Mev. A qualitative comparison of the results is made with the Wilkinson model.

Microfilm \$2.50; Xerox \$5.00. 96 pages.

### TOTAL GAMMA ABSORPTION IN $C^{12}$ , $N^{14}$ , $O^{16}$ , AND $Al^{27}$ , AT 20 MEV.

(L. C. Card No. Mic 60-3569)

Edward Elmer Carroll, Jr., Ph.D.  
University of Pennsylvania, 1960

Supervisor: Dr. W. E. Stephens

Total gamma absorption cross-sections of  $C^{12}$  from 20.0 to 21.15 Mev, and of  $N^{14}$ ,  $O^{16}$ , and  $Al^{27}$  from 20.0 to 20.5 Mev, were measured using monochromatic gamma rays.

A direct absorption technique was used in which samples were placed between the target of an electrostatic generator, and large sodium-iodide scintillation detectors.

Monochromatic photons from the  $T^3(\rho, \gamma)He^4$  reaction were varied in energy by changing the energy of the incident protons.

The  $C^{12}$  cross-section showed pronounced structure with resonances resolved at 20.15 Mev, 20.46 Mev, and 20.92 Mev, with integrated cross-sections of 1.1, 1.0, and 6.6 Mev-millibarns respectively. Oxygen showed a sharply rising cross-section suggesting a strong resonance peaked above about 20.5 Mev. The cross-sections of  $N^{14}$  and  $Al^{27}$  were smooth over the energy interval investigated. Microfilm \$2.50; Xerox \$6.20. 130 pages.

### PART I. MESON THEORETICAL CORRECTION TO NUCLEAR FORCE IN COMPLEX NUCLEI. PART II. HYPERHEAVY NUCLEI.

(L. C. Card No. Mic 60-3570)

Kee Won Chun, Ph.D.  
University of Pennsylvania, 1960

Supervisor: Keith A. Brueckner

Part I. The purpose of this work is to evaluate the exclusion principle correction to be applied to the meson theoretical potential for the isolated pair of nucleons when the pair is imbedded in the Fermi distribution, and also to evaluate the three-body forces arising from two-pion exchanges among three nucleons in (ps) pv-coupling theory in Fermi gas.

Meson theoretical potential used in this work for the exclusion principle correction is the Wigner-type central fourth-order Brueckner-Watson potential  $v_{BW}(r)$ , which has all the essential features of the meson theoretical potential. At first, this correction is carried out for (1) when the pair is inside the Fermi sphere, feeling the average exclusion principle effects of the Fermi distribution, whose average momentum  $\bar{p}$  is given by  $\bar{p}^2/2M = (3/5)p_F^2/2M$ , and (2) when the pair is excited outside the Fermi sphere with the relative momentum  $p_F$  and  $2p_F$ . Then expanding the potential in a power series in the relative momentum, and by making use of the above exclusion principle corrections for three different momentum states, an over-all exclusion principle correction is attained, which is negligibly small.

The three-body potential is reduced to an effective two-body potential by averaging the spin and the isotopic spin, and by space integrating, over the third nucleon in the Fermi distribution, which then takes on features characteristic of the meson theoretical second-order potential. The contribution to the binding energy coming from this effective two-body potential in the Fermi distribution is about 4% of that coming from the second-order potential.

Thus this work actually proves the long existing conjecture that these effects are small.

Part II. The purpose of this work is to study the properties and stability of a hypothetical nuclear system, "hyperheavy nuclei," defined as the nuclear system which was initially a Fermi gas consisting of large number of neutrons. Study of the neutron binding a energy from high and low density side gives the evidence that the neutrons

may be just barely bound in this system. This system turns out to be stable against fission and perturbation. However,  $\alpha$ - and heavy-particles formed through the combinations of protons and neutrons in the hyperheavy nuclei may have positive or negative energy eigenvalues, depending on the magnitude of the proton binding energy, which we cannot determine accurate enough at the present. If they have positive energy eigenvalues, then they can easily penetrate the potential barrier, which is obtained by means of Fermi-Thomas statistical treatment. On the other hand, if, for example, the proton binding energy is taken to be the value estimated in our work of 26 Mev, then they have negative energy eigenvalues, and so they cannot be emitted through quantum mechanical effects.

Both neutron and proton binding energies, especially the proton binding energy, should be determined accurately to decide whether this system is  $\alpha$ - and heavy-particle stable. Microfilm \$2.50; Xerox \$5.80. 119 pages.

#### SCATTERING OF 3.4 MEV POLARIZED NEUTRONS BY COPPER AND ZINC

(L. C. Card No. Mic 60-4596)

Grover Cleveland Cobb, Jr., Ph.D.  
University of Virginia, 1960

Partially polarized neutrons from the  $D(d,n)He^3$  reaction were elastically scattered by copper and zinc and the right-left asymmetry measured over the angular range from  $30^\circ$  -  $135^\circ$ . The elastic scattering polarization for copper and zinc was inferred from the measured asymmetries. The polarization can be correlated with the differential scattering cross sections for copper and zinc; that is with minima in the cross sections and nodes in the polarization occurring at the same angles. The polarization angular distributions of copper and zinc are very similar as are their differential cross sections. The maximum values of polarization for both these elements occurs at about  $120^\circ$  and is approximately 40%.

Microfilm \$2.50; Xerox \$3.00. 48 pages.

#### PHOTONEUTRON CROSS SECTION FOR LITHIUM AND A DIRECT DETECTION SYSTEM FOR PHOTOPROTONS

(L. C. Card No. Mic 60-4602)

Ronald Walter Fast, Ph.D.  
University of Virginia, 1960

The photodisintegration of lithium has been studied using bremsstrahlung from the University of Virginia electron synchrotron. The photoneutron yield from a metallic lithium target has been measured with a detection array of boron trifluoride counters in a paraffin block. The yield was secured at machine energies in the range of 10 to 55 Mev at one Mev intervals. Irradiation dosage was monitored with a parallel plate ionization chamber, calibrated by the National Bureau of Standards. A reduced yield was calculated and a modified Penfold-Leiss

matrix was used to derive the photoneutron cross section as a function of gamma-ray energy. The cross section obtained exhibits the usual giant resonance with a cross section of  $3.2 \pm 0.8$  mb at a gamma-ray energy of  $19 \pm 4$  Mev. The value of the cross section integrated over energy to 25 Mev was 38 Mev-mb and to 51 Mev was 90 Mev-mb, indicating the existence of a tail on the cross section of considerable magnitude in the region between 25 and 50 Mev. The value of the maximum cross section and the resonance energy agree with previous experiments, but the high energy tail on the cross section has not been reported earlier.

A direct detection system for measuring the energy distribution of photoprotons has been developed. The system utilizes a 0.0133" cesium iodide crystal as the scintillator. The response of the crystal to protons was measured using protons of known energy from the  $B^{10}(d,p)C^{11}$  reaction. A multi-channel analyzer was used to record the energy spectrum of the photoprotons from carbon. An x-ray beam of energy 65 Mev, with a time duration of 200 microseconds was used. The carbon target had a thickness of 23 mg/cm<sup>2</sup> to reduce proton energy loss in the target itself. Aluminum absorbers were used to view various regions of the proton energy spectrum. The efficiency of the detection system as a function of proton energy was calculated for several target and absorber thicknesses, and the energy distribution of photoprotons from carbon was measured over a proton energy range from 2.0 to 22.5 Mev. The average statistical uncertainty on the measured points was 3.5%. The energy spectrum had a maximum at a proton energy of 4.5 Mev, which agrees with results previously reported.

Microfilm \$2.50; Xerox \$4.60. 87 pages.

#### PROTONS FROM THE 14 MEV NEUTRON REACTION WITH COBALT

(L. C. Card No. Mic 60-4762)

Joseph R. Hearst, Ph.D.  
Northwestern University, 1960

The present research is an attempt to gain some information on the mechanism involved in the (n,p) reaction for cobalt at 14.1 Mev by measurements of energy distribution, angular distribution and total cross section of the emitted protons. Cobalt was chosen in order that the results obtained might be compared with results found by other workers in its shell model neighbors. In recent years neutron and proton induced nuclear reactions in medium and heavy nuclei at intermediate energy have been studied. The results of these studies may be grouped within the two extremes; interaction through a compound nucleus and direct interaction. However, it is still difficult to say which of the two mechanisms is more significant.

A tritium gas target was used as a 14.1 Mev neutron source, utilizing the reaction  $T^3 + D^2 \rightarrow He^4 + n^1 + 17.578$  Mev, with the Northwestern University 5 Mev electrostatic accelerator. The gas target assembly consisted of two cells, one containing the tritium and one containing a hydrogen-helium mixture for cooling the two 0.0004 inch molybdenum foils. The neutron beam was



collimated by a 24 inch stack of steel plates with an hour-glass shaped hole. Ilford G-Special 400 micron emulsion plates were exposed in a multiple plate camera shielded by paraffin. The incident time-integrated neutron fluxes were measured by counting the positrons from  $Zr^{88}$  which was obtained by the reaction  $Zr^{90}(n,2n)Zr^{88}$ . The neutron flux at the target position was  $5.71 \times 10^8$  neutrons per  $cm^2$  for the background exposure and  $4.62 \times 10^8$  neutrons per  $cm^2$  for the cobalt exposure. A total of about 250 tracks for the background and about 950 tracks for the exposure with a target were measured.

The energy distribution of protons from the (n,p) reaction peaks at about 2 Mev. This distribution can be very roughly fitted by a statistical model calculation in which a penetration factor is obtained by assuming a Woods-Saxon type diffuse nuclear potential instead of a square well, and assuming that approximately 25% of the observed tracks are actually due to an (n, $\alpha$ ) reaction. This low energy peak could also, energetically, result from an (n,np) reaction, but no theoretical fit to this was obtained. Assuming the 25% (n, $\alpha$ ), the nuclear temperature was found to be 1.5 Mev.

The angular distribution below 5.5 Mev can be interpreted as roughly isotropic, consistent with statistical model, or having a forward dip, possibly consistent with direct interaction. Above 5.5 Mev, the angular distribution has a forward peak, consistent with direct interaction.

The total cross section for emission of charged particles from cobalt is found to be  $107 \pm 16$  mb. If the assumption of an (n, $\alpha$ ) cross section of  $27 \pm 6$  mb is made, then the (n,p) cross section is  $80 \pm 17$  mb. This is consistent, probably fortuitously, with a value of 63 mb calculated from statistical model.

This is the second in a proposed series of experiments of which Zr (n,p) was the first.

Microfilm \$2.50; Xerox \$5.60. 112 pages.

#### POLARIZATION EFFECTS IN NEUTRON-PROTON SCATTERING

(L. C. Card No. Mic 60-4608)

Ralph Edward Kelley, Ph.D.  
University of Virginia, 1960

From the quadrupole moment of the deuteron it is known that the interaction between nucleons in the neutron-proton system is not a purely central force but is dependent on spins. In view of the spin dependence it is reasonable to suppose that in a scattering process the potential will somehow sort the particles according to their spins, producing a polarized beam.

This research involves a computation of the polarization to be expected in neutron-proton scattering at low energies under the tensor force.

Numerical phase shifts were calculated for an energy of 1.5 Mev; effectively no polarization was found at this energy.

Since the numerical computation of phase shifts needed in polarization and cross section formulas is very tedious, it was thought advisable to attempt to find an analytical description of the variation of phase shifts with energy. The approach used was similar to that of the Breit-Wigner

resonance theory, except that the inclusion of the tensor force required extension of the theory to coupled angular momentum states.

Microfilm \$2.50; Xerox \$3.00. 37 pages.

#### NONLINEAR SPACE DEPENDENT REACTOR KINETICS

(L. C. Card No. Mic 60-3725)

Gerald Stanley Lellouche, Ph.D.  
North Carolina State College, 1960

Supervisors: Raymond Leroy Murray and  
Jack Chernick

A very general mathematical model for the axial space dependent kinetics of a fixed fuel, flowing coolant-moderator system is presented. This model takes into account the radial dependence by the use of appropriately derived delay times. It considers the possibility of both prompt and delayed reactivity coefficients as well as an arbitrary external forcing function and six delayed emitter groups.

The system of equations is programmed for the IBM 704 by means of the Fortran II routine. Subroutines make it possible to vary the coolant velocity, external reactivity and inlet temperature as well as permitting various types of output.

A study of the effects of various perturbations on the SPWR model leads to the conclusions that: spatial distortions can be more serious for some spatially uniform insertions of reactivity than for equivalent space dependent insertions caused by lowering the inlet coolant temperature; continued loading of a reactor (with more initial reactivity) at constant coolant velocity leads to highly skewed power distributions with very low power over most of the core; lowering the inlet temperature leads to serious cycling of the power.

Microfilm \$3.05; Xerox \$10.60. 233 pages.

#### THE RADIOACTIVE DECAY OF HAFNIUM AND THULIUM ISOTOPES

(L. C. Card No. Mic 60-4120)

Hanumanthappa Narasimhaiah, Ph.D.  
The Ohio State University, 1960

#### RADIOACTIVE DECAY OF $Hf^{172}$

Ytterbium oxide enriched to 81.4% in the mass number 170 was irradiated with 24-Mev alpha particles. By the use of a 3 x 3 inch NaI(Tl) crystal and a 100-channel analyzer, the spectrum of the long-lived material showed gamma rays with energies of 80, 123, 182, 273, 343, 527, 697, 809, 908 and 1093 kev. Comparison of this complex spectrum with the spectra of  $Hf^{175}$ ,  $Lu^{175}$  and  $Lu^{172}$  revealed that the gamma rays with energies of 273 and 343 kev belong to  $Lu^{175}$  and  $Hf^{175}$  respectively, and those with energies of 182, 527, 697, 809, 908 and 1093 kev belong

to  $\text{Lu}^{172}$ . Observations made earlier in the decay showed the 24-hour  $\text{Hf}^{173}$  spectrum also.  $\text{Hf}^{173}$  activity is produced by the 7.8 per cent of  $\text{Yb}^{171}$  in the given sample.  $\text{Hf}^{173}$  decayed into  $\text{Lu}^{173}$ .  $\text{Hf}^{175}$  activity was made by  $(\alpha, n)$  reaction from the 4.2 per cent  $\text{Yb}^{172}$  in the sample. From the complex spectrum spectra of  $\text{Hf}^{175}$ ,  $\text{Lu}^{173}$  and  $\text{Lu}^{172}$  were subtracted on the 100-channel analyzer for suitably determined time intervals. The net spectrum contains Lu K x-rays and gamma rays with energies of  $80 \pm 2$  and  $123 \pm 3$  kev respectively. The half-life of the net spectrum is of the order of five years. The two gamma rays are not in coincidence. The  $\text{Lu}^{172}$  spectrum consists of levels at 80 (3+) and 123 (3-) kev. The decay of  $\text{Hf}^{172}$  into 123 kev level is about 70 per cent and to the 80 kev level is about 30 per cent.

#### RADIOACTIVE DECAY OF $\text{Hf}^{173}$

Ytterbium oxide enriched to 93.8 per cent in the mass number 171 was irradiated with 24-Mev alpha particles. Analysis of the spectrum of  $\text{Hf}^{173}$ , which is produced by  $(\alpha, 2n)$  reaction of  $\text{Yb}^{171}$ , consisted of Lu K x-ray and gamma rays of  $125 \pm 2$ ,  $135$ ,  $162 \pm 2$ ,  $300 \pm 3$ ,  $357 \pm 5$ ,  $545 \pm 5$ ,  $720 \pm 7$ ,  $890 \pm 10$ ,  $1040 \pm 10$ ,  $1210 \pm 15$ , and  $1485 \pm 20$  kev decaying with a half-life of  $23.8 \pm 0.7$  hours. The presence of 135 kev gamma ray was detected only in the coincidence spectrum. 135 kev gamma ray is in coincidence with gamma rays of energy 162, 545, 720 and 890 kev. The 300 kev gamma ray is in coincidence with the 545 kev gamma ray. The energy level diagram of  $\text{Lu}^{173}$  accounts for 33 transitions out of a total of 36 obtained from internal conversion. The energy level diagram of  $\text{Lu}^{173}$  consists of levels at 124 (7/2+), 129 (5/2+), 264 (7/2+), 426 (5/2-), 436, 891, 977, 984, 1005, 1165, 1335, 1602, 1614 and 1988 kev. There seems to be no decay to 124 and 129 kev levels. About 32 per cent of the decay goes to the 264 kev level and about 66 per cent goes to the 426 and 436 kev levels. The observed relative intensities of the K x-ray : gamma rays of energy (in kev)  $125 : 300 : 545 : 720 : 890 : 1040 : 1210 : 1485 = 101 : 100 : 46 : 1.7 : 1.3 : 3.1 : 0.3 : 0.2$ .

#### RADIOACTIVE DECAY OF $\text{Tm}^{167}$

Erbium oxide enriched to 58.8 per cent in the mass number 167 was irradiated with 12-Mev deuterons. The following were the percentages of other isotopes presented in the sample:  $\text{Er}^{166}$ , 14;  $\text{Er}^{168}$ , 25.3; and  $\text{Er}^{170}$ , 1.93.

The spectrum consisted of the Er K x-ray and gamma rays of 57, 81.5, 207, 450, 534, 640, 730, 820, 1015, 1280, and 1465 kev. Comparison of the above spectrum with the spectrum of  $\text{Tm}^{168}$  showed that all the gamma rays except those with energies of 57, 207, and 534 kev belong to  $\text{Tm}^{168}$ . An earlier observation had revealed the 7.7 hour  $\text{Tm}^{166}$  spectrum also. The presence of  $\text{Er}^{168}$  and  $\text{Er}^{166}$  in the sample accounts for the  $\text{Tm}^{168}$  and  $\text{Tm}^{166}$  activities. Hence the Er K x-ray and gamma rays with energies of 57, 207 and 534 kev decaying with a half life of 9.58 days belong to  $\text{Tm}^{167}$ . None of the gamma rays are in coincidence. The energy level diagram of  $\text{Er}^{167}$  contains levels at 80 (9/2+, 7/2), 172 (11/2+, 7/2), 207 (1/2-, 1/2), 264 (3/2, -1/2) and 534 (5/2-, 5/2) kev.

Microfilm \$2.50; Xerox \$4.20. 77 pages.

#### NUCLEAR LEVEL PARAMETERS FROM RESONANCE FLUORESCENCE AT 7 MEV

(L. C. Card No. Mic 60-3609)

Kurt Reibel, Ph.D.

University of Pennsylvania, 1960

Supervisor: A. K. Mann

The recoil broadened photons from the  $\text{F}^{19}(\rho, \alpha \gamma)\text{O}^{18}$  reaction have been used to obtain the elastic photon scattering cross sections around 7 Mev for 31 elements. Angular distribution measurements indicate that the transitions are predominantly dipole. A plot of the cross sections against A shows definite peaks around the closed shell regions near  $Z = 50$ ,  $N = 82$  (Sn, Te, Ba) and  $Z = 82$ ,  $N = 126$  (Pb, Bi). Self absorption measurements have been performed for 8 elements and values for the average radiative width to ground state, total radiative width, and average level spacing have been obtained for each of these elements. These values are significantly different from those obtained from slow neutron capture in heavy elements. The radiative widths are several times larger, the average level spacing is greater by a factor of about 100, and the branching ratios to the ground state are also greater by a factor of about 100. The levels we observe are characterized by large ground state transition probabilities and radiative widths larger than any yet observed with neutrons. Several of the elements were done at a higher proton bombardment energy where the 7.12/6.91 Mev photon intensity ratio is 1/4 instead of 4, at which ratio most of the measurements were performed, and the elastic cross sections do not change appreciably in most cases. The largest change occurs in lead whose cross section around 7.12 Mev is about 3 times that at 6.91 Mev. A possible explanation for the difference between the average level parameters as obtained in photon scattering compared with those from the neutron work is proposed.

Microfilm \$2.50; Xerox \$7.00. 148 pages.

#### PART I. COLLECTIVE EXCITATION OF A FERMI GAS.

#### PART II. SUPERFLUIDITY OF NUCLEAR MATTER AND LIQUID HELIUM THREE.

(L. C. Card No. Mic 60-3696)

Toshio Soda, Ph.D.

University of Pennsylvania, 1960

Supervisor: Keith A. Brueckner

Part I. The collective excitations of a Fermi gas with attractive interactions are investigated by using superconductivity methods and field theoretic techniques. A dispersion equation for the excitation is solved exactly for the first time to the fourth power of the coupling constant and the square of the momentum transfer. The effective mass, involved in the expression for the excitation energy, turns out to be equal to those derived both from the sound velocity in a Fermi gas and from the self energy of a Fermion. These results are applied to the



collective oscillations of nuclear matter (Goldhaber-Teller) and stable modes of excitation are obtained, along with the resonance widths. The excitation energy is about 18 Mev. for medium nuclei.

Part II. The superfluidity of a bound Fermion system with attractive potentials in individual angular momentum states, is investigated. The technique involves the Brueckner K matrix as the effective interaction as well as Bogoliubov's quasi-particle formalism and obtains a directionally dependent energy gap. Comparison with the B.C.S. formalism shows the equivalence of these two methods. Extension to the finite temperature case gives distribution functions which in turn yield the transition temperature and the discontinuity in the specific heat. These results are then applied to liquid helium three, and to nuclear matter. In the case of the former, we obtain a transition temperature of about .1° K. For nuclear matter we calculate an energy gap, due to the  $^3S_1$  state of a few tenths of a Mev.

Microfilm \$2.50; Xerox \$6.00. 124 pages.

#### BINDING ENERGIES OF HYPERFRAGMENTS FROM $K^-$ CAPTURE

(L. C. Card No. Mic 60-4799)

Phillip Henry Steinberg, Ph.D.  
Northwestern University, 1960

A hyperfragment is a structure consisting of a  $\Lambda^0$ -particle bound to a light nucleus. The purpose of this investigation was to determine the energies with which the  $\Lambda^0$ -particle is bound to various light nuclei.

Mesonic hyperfragments (i.e., hyperfragments which decay by pion emission) are especially well suited for binding energy determination due to their relatively small decay energies.

Hyperfragments are frequently produced as a product of the interaction of  $K^-$  mesons and complex nuclei. The yield of mesonic hyperfragments in  $K^-$  interactions in nuclear emulsions is around 1%.

Out of 112 possible mesonic  $\Lambda^0$ -hyperfragment events found in an emulsion stack exposed to stopping  $K^-$  mesons, 88 were completely measurable and 48 could be uniquely identified. The binding energies of the 48 unique events have been determined and are given in the following table.

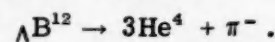
Binding Energies From  
Uniquely Identified Mesonic Decays

Hyperfragment	Binding Energy (Mev)	Number of Events
$\Lambda H^3$	$-1.2 \pm 0.8$	1
$\Lambda H^4$	$1.97 \pm 0.32$	8
$\Lambda He^4$	$2.11 \pm 0.26$	5
$\Lambda He^5$	$2.93 \pm 0.13$	25
$\Lambda Li^7(2 \text{ body})$	$6.73 \pm 0.65$	1
$\Lambda Li^7(\text{other})$	$5.93 \pm 0.58$	1
$\Lambda Li^8$	$6.60 \pm 0.50$	3

#### Binding Energies (cont.)

Hyperfragment	Binding Energy (Mev)	Number of Events
$\Lambda Li^9$	$6.5 \pm 2.9$	1
$\Lambda Be^9$	$6.52 \pm 0.44$	2
$\Lambda Be^{12}$	$9.98 \pm 0.61$	1

The  $\Lambda B^{12}$  event, the first of its kind to be reported, decayed according to the scheme



The emulsion stack consisting of fifty-nine K-5 and seventy-one L-4, four-inch x six-inch x 600 micron Ilford pellicles was exposed to  $K^-$  mesons at the Bevatron in December, 1957. The stack was processed at Northwestern University using the standard techniques. Technicians were trained to locate the hyperfragment events by systematic area scanning and the directional coordinates and ranges of the decay prongs for each event were carefully measured.

Kinematic analysis of the events were carried out with the Northwestern University IBM-650 digital computer. In the analysis, an attempt was made to find a single set of particle assignments for the decay prongs of a given event, giving zero total momentum and an acceptable binding energy. The hyperfragment is generally assumed to decay at rest.

The usual requirement on the binding energy is that it be positive. However, for events assigned to a well-populated hyperfragment specie, one requires also that binding energy be consistent within errors with the known binding energy of that specie.

Data on binding energies of  $\Lambda^0$ -hyperfragments is expected to give information on the specific  $\Lambda^0$ -nucleon force responsible for the binding. Such data should be sensitive to the strength, spatial and spin dependence of that force. Microfilm \$2.50; Xerox \$5.80. 117 pages.

#### PHOTONEUTRON CROSS SECTION OF MANGANESE

(L. C. Card No. Mic 60-4625)

Robert Simpson Tickle, Ph.D.  
University of Virginia, 1960

The total photoneutron yield for manganese has been carefully measured from threshold to approximately 30 Mev. Analysis of the data indicates that the giant resonance of the total neutron production cross section shows a splitting into two resolvable peaks in accord with the predictions based on a classical hydrodynamic model of the nuclear photo-effect. The  $Mn^{55}$  peaks occur at energies of  $16.8 \pm .25$  Mev and  $19.75 \pm .25$  Mev corresponding to cross sections of 89 mb and 77 mb respectively. Corrections for the neutron multiplicity occurring in the  $(\gamma, 2n)$  reaction were based on the nuclear statistical model. The cross section  $\sigma(\gamma, n) + \sigma(\gamma, np) + \sigma(\gamma, 2n)$  integrated to 30 Mev is 687 Mev-mb. A superposition of two Breit-Wigner resonance lines were fitted to the cross section and the intrinsic quadrupole moment determined

from this fit is  $+ .78 \pm .1$  barns. Comparisons are made with the intrinsic quadrupole moments determined by other methods and are found to be in reasonable agreement. Existing theoretical explanations for the width and shape of the dipole giant resonance are discussed and compared to the results obtained for manganese when applicable. Microfilm \$2.50; Xerox \$5.00. 100 pages.

#### AN APPROXIMATION METHOD FOR HIGH-ENERGY POTENTIAL SCATTERING

(L. C. Card No. Mic 60-3840)

Jerome Johnson Tiemann, Ph.D.  
Stanford University, 1960

At very high energies, the analysis of scattering experiments by the method of partial waves becomes more and more tedious. The reason for this is twofold: first, one needs to calculate more partial waves before the series converges; and second, it becomes more difficult to achieve the necessary accuracy in the phase shifts as the energy (wave number) increases.

This fact makes three-dimensional approximations (like the Born approximation) look more attractive at high energies. The trouble with the Born approximation is that it is not accurate enough for most cases of practical interest.

This dissertation presents an approximation method which, contrary to the case of the Born approximation, improves in accuracy as the wave number of the scattered particle increases. We follow a method due to D. S. Saxon and L. I. Schiff<sup>1</sup> for casting the expression for the scattering amplitude of a particle obeying Schrödinger's equation in the form

$$f(\underline{k}, \underline{k}_f) = \text{const.} \int V(\underline{r}) e^{iL(\underline{r})} d\tau,$$

where  $V(\underline{r})$  is the scattering potential and where  $L(\underline{r})$  is the total phase along both incoming and outgoing directions to the point  $\underline{r}$ .

An asymptotic expansion of this integral in powers of  $V/E$  is then developed. Here  $E$  is the kinetic energy of the particle. At the maximum of the cross section two terms are given, while at the minimum only the final non-vanishing term is calculated.

Comparison of these results is then made for the case of a parabolic well potential with an exact numerical integration of Saxon and Schiff's equation, and a previous asymptotic expansion of it in inverse powers of the wave number of the scattered particle. Because of the practical interest, comparison is also made with the Born approximation and with an exact partial wave analysis of the scattering cross section.

A similar calculation is then done for the case of electron scattering from a uniformly charged sphere. The resulting formula is evaluated numerically at two different energies for the cases when the total charge on the sphere is 22e (titanium) and 79e (gold).

The effect of fuzzing out of the surface of the sphere is then calculated as a power series in the ratio of the surface width to the radius of the sphere. The result, which is applicable to electron scattering from a spherical nucleus with a smoothed-out charge distribution is thus

expressed as a combined power series in  $V/E$  and  $a/R$ , where  $a$  and  $R$  are the surface thickness and radius of the nucleus, respectively.

Further application of our methods to the calculation of the first order change in the scattered amplitude induced by a change in the scattering potential are presented, and an interpolation scheme based on a semi-classical wave function is developed. In this scheme, it is assumed that the exact scattered amplitude for one nuclear charge distribution has been calculated at the energy of interest. The change in the scattering amplitude induced by a slight redistribution of the charge is given as a power series in  $V/E$ . Here also, the accuracy is superior to that attainable with the Born approximation.

1. D. S. Saxon and L. I. Schiff, *Nuovo cimento* **VI**, 614 (1957).

Microfilm \$2.50; Xerox \$3.00. 48 pages.

#### THE MEASUREMENT OF ELECTRON POLARIZATION BY ELECTRON-ELECTRON SCATTERING

(L. C. Card No. Mic 60-4007)

Jack Donald Ullman, Ph.D.  
University of Illinois, 1960

The longitudinal polarization of electrons and positrons from beta decay was measured by electron-electron (Møller) and electron-positron (Bhabha) scattering at energies above 460 kev. Approximately monoenergetic electrons were chosen by a beta monochromator and the energy dependence of the polarization was investigated. Corrections were calculated for finite counter apertures and depolarization of the electrons. Precautions were taken to eliminate or account for spurious effects. The results show a polarization of  $-v/c$  for electrons from  $\text{Au}^{198}$  and  $\text{P}^{32}$ , and  $+v/c$  for positrons from  $\text{Ga}^{68}$ . Electrons from  $\text{RaE}$  show a polarization of about  $-0.75 v/c$ , nearly energy independent between 500 and 950 kev.

A discussion of the Møller scattering method for measuring electron polarization is presented.

Microfilm \$2.50; Xerox \$4.20. 78 pages.

#### PHYSICS, SOLID STATE

##### A STUDY OF LOW TEMPERATURE ELECTRICAL RESISTANCE RECOVERY IN COLD WORKED COPPER CRYSTALS\*

(L. C. Card No. Mic 60-3884)

James Havens Bredt, Ph.D.  
University of Illinois, 1960

Single crystals of 99.998% pure copper were compressed by a nearly uniaxial stress at 78°K, and measurements of their electrical resistance as a function of time



were made at constant temperatures between 78°K and 330°K. The measurements of the potential drop across the specimens had enough sensitivity and precision to measure changes amounting to one unit in the fifth significant figure, and the size of the potential ranged from 130 to 760 microvolts. The specimen temperature was measured with a precision approaching  $\pm .001^\circ\text{K}$ , so that the precision of the original potential measurements was preserved in the values of the specimen resistances after they were corrected for small temperature variations which occurred during the anneals. Annealing was continuous in the specimens over the whole temperature range, and in some time intervals the resistances were actually observed to increase. The increases were not confined to unique temperature ranges, but were interspersed rather irregularly among the intervals in which the resistances decreased. Analysis of the data indicates that the annealing involved a very complex spectrum of processes whose activation energies were continuously distributed over an interval at least as wide as 0.6 eV, and reached energies at least as high as 0.8 eV. The detailed dependence of the electrical resistance recovery in a particular specimen on time and temperature was found to be quite sensitive to the specimen's thermal history. Ageing of a specimen at low temperatures appeared to promote the appearance of transient resistance increases in the temperature range below 200°K. In particular, it was observed that this ageing effect was present in a specimen which was aged near the normal boiling point of liquid nitrogen. The specimen's resistance was noticeably increased by ageing periods lasting 12 hours or longer at that temperature. Auxiliary measurements were made to determine the mode of deformation and the dependence of the recoverable resistivity increment on the strain produced in a specimen. It was found that the rate of work-hardening in a compressed specimen increases sharply at the transition from single to double slip, and that this is associated with a rise in the rate of increase of the recoverable resistivity increment. The geometrical changes in the specimens due to deformation were found to deviate from the ideal behavior predicted by the theory of plastic flow in crystals. The deviations from ideal behavior could be represented by the assumption that slip took place only on the slip planes most favored by the applied stress, but that more than one type of dislocation was produced on each effective slip plane so that the resultant slip direction was slightly rotated away from the ideal one and toward the stress axis. The data are discussed in terms of a model of aggregates of point defects produced by systems of expanding dislocation loops, and several further experiments are proposed.

\*Research supported in part by the Office of Naval Research.

Microfilm \$2.50; Xerox \$4.80. 95 pages.

# MULTI-PHONON PROCESSES OCCURRING IN FIRST ORDER TIME DEPENDENT PERTURBATION THEORY

(L. C. Card No. Mic 60-4753)

Edmund George Franzak, Ph.D.  
Northwestern University, 1960

Adviser: Martin H. Bailyn

The primary problem undertaken in this thesis is to develop a method for treating multi-phonon processes within the framework of first order time dependent perturbation theory and to determine the probability of such transitions. The perturbation matrix element is separated into two factors -- the first is a matrix element of a single ionic potential function screened by the conduction electrons while the second factor is a matrix element which involves the phonon creation and annihilation operators as a sum of terms representing single phonon processes, double phonon processes and so on. In order to effect this separation however, we must characterize the electronic states by plane waves rather than Bloch functions. We further assume that the electron-phonon collisions are completely elastic and restrict our considerations to temperatures above the Debye temperature. Under these conditions we obtain expressions for electron transition probabilities involving double phonon processes as a special case of multi-phonon transitions though the general method of extending the calculation to  $n$  phonon processes is indicated. The shielding effect of the conduction electrons on the ionic potential is estimated by means of a Fermi - Thomas statistical model. While the ionic charge distribution that is implied appears somewhat crude, we make a comparison with the more rigorous Bardeen theory and demonstrate that the two models are strikingly close.

Having obtained expressions for these transition probabilities, we then proceed to determine their effect on electrical conductivity as a representative electron transport phenomenon. Our intention, as far as application of multi-phonon transition probabilities is concerned, is not so much to investigate the basic mechanism of electrical conductivity nor indeed even to attempt a more rigorous physical model than those suggested by previous investigators but rather, accepting the usual description of electron - lattice interaction, to develop in a consistent fashion a method for determining the effect on electrical conductivity provided by simultaneous creation or annihilation of two phonons in a single electronic transition. The Boltzmann equation for the electronic distribution function is solved by assuming a constant relaxation time and an expression for the electrical conductivity is obtained, as customary, in terms of this relaxation time. A calculation is made of the single and double phonon contributions to the relaxation time involving both ordinary processes which conserve the pseudo-momentum of the electron - phonon system and umklapp processes which do not. In this way we calculate the electrical conductivity of the monovalent metals Na, K, Rb and Cs as functions of the absolute temperature. In each case the conductivity calculated on the basis of single phonon processes only is in reasonable agreement with results obtained by other investigators. The effect of double phonon processes on electrical conductivity is to produce a reduction of approximately four percent from the single phonon value at

0°C. The effect increases slightly with the weight of the element except for some anomalous behavior on the part of Cs where it decreases. This decrease may be due to incorrect elastic constants resulting in incorrect Debye temperatures. Any manifestation of double phonon processes should be observed as a non-linearity in the resistance vs. temperature curve. While such a non-linearity is indeed exhibited it is considerably more than can be accounted for by double phonon processes alone. It is quite likely that lattice defects are generated at elevated temperatures thus changing the average force constants and having a profound effect on the Debye temperatures.

Microfilm \$2.50; Xerox \$5.80. 116 pages.

#### THE PRODUCTION OF VACANCIES IN PULSED GOLD

(L. C. Card No. Mic 60-3934)

James Joseph Jackson, Ph.D.  
University of Illinois, 1960

Specimens of 99.999% pure, well annealed, gold wire  $2 \times 10^{-3}$  inches in diameter were pulse heated to temperatures in the range 650°C to 900°C. The time to reach the quench temperature was about sixty microseconds. The specimens were held at the high temperature for times from  $5 \times 10^{-4}$  second to twenty seconds with a maximum temperature variance of  $\pm 3^\circ\text{C}$ . They were then quenched by convective cooling in a helium atmosphere. The cooling curve was nearly exponential with the temperature dropping halfway to 78°K in  $10^{-2}$  second.

This heat treatment increased the specimen resistance above the annealed value. Annealing studies showed that the additional resistance is due to quenched in lattice vacancies since the activation energy associated with the annealing of a wire pulsed to 700°C or less is that appropriate to the motion of single vacancies. The annealing kinetics after quenches from 800°C are more complex and correspond to the motion of both single vacancies and divacancies.

On energetic grounds vacancies can be produced at the observed rate only at grain boundaries or dislocations. The contribution to the resistance due to vacancies from grain boundaries amounted to about one-fifth of the total increment. The resistance due to vacancies from dislocations varied as  $\Delta R(\infty)[1 - \exp(-\alpha t)]$  where  $t$  is the time at the elevated temperature,  $\Delta R(\infty)$  is the equilibrium resistance quenched in at that temperature, and  $\alpha$  is  $B \exp(-1.04/kT)$ . The activation energy for this process is greater than that for vacancy motion because of the climb of the dislocations as they add atoms from the lattice. In the temperature range of this experiment the climb distance is comparable to the distance the vacancies diffuse. Since the amount of climb depends more strongly on temperature than the average diffusion distance does, the vacancy gradient at the dislocations was enhanced at high temperatures relative to that at low temperatures. This caused the vacancy flux to increase more rapidly with temperature than it would if there were no climb.

The vacancies were created singly at the jogs in the dislocations and diffused through the lattice at high temperatures as single vacancies. The time to produce half

the equilibrium resistance increment varied from  $16 \times 10^{-3}$  second at 800°C to  $80 \times 10^{-3}$  second at 650°C. The initial annealing rate,  $d(\Delta R)/(\Delta R)dt$  was greater in pulsed wires than in wires quenched with the equilibrium vacancy concentration at the same temperature. This shows that the same dislocations act as both sources and sinks of vacancies. Microfilm \$2.50; Xerox \$4.00. 71 pages.

#### ELECTRON SPIN RESONANCE IN NEUTRON IRRADIATED SILICON

(L. C. Card No. Mic 60-4197)

Martin Nisenoff, Ph.D.  
Purdue University, 1960

Major Professor: H. Y. Fan

Electron spin resonance of lattice imperfections produced in silicon by fast neutron irradiation has been investigated. Measurements were made at microwave frequencies of 9200 and 24,000 Mc/s at temperatures between room temperature and liquid helium temperature.

In samples which had attained intrinsic resistivity after irradiation, the resonance signal did not depend on concentration or nature of the chemical impurities in the sample or on the concentration of oxygen in the sample. The magnitude of the signal was proportional to the neutron flux. The production rate of the centers responsible for the observed resonance signal was about 0.1 centers per  $\text{cm}^3$  per neutron per  $\text{cm}^2$ . At liquid helium temperature, the relaxation time was of the order of 0.1 seconds and the absorption signal was saturated for the range of microwave power used. At room temperature the relaxation time was sufficiently short allowing the detection of the absorption signal. The derivative of both the absorption and dispersion signals indicated the presence of fine structure which was anisotropic with respect to the orientation of the sample in the magnetic field. Portions of the signal annealed out after heat treatments of 2 hours at 170°C and of one hour at 300°C. The remaining portion of the resonance pattern, which is due to at least two distinct centers, was stable under annealing at 500°C for about 8 hours. Attempts to correlate portions of the resonance signal with the infrared bands found in irradiated silicon have not been successful.

Different resonance signals were found in samples which had not achieved intrinsic resistivity due to the irradiation. The nature of the signal depended on the position of the Fermi level in the sample. None of the five patterns found in the non-intrinsic samples had any line in common with one another or with the signal found in the intrinsic samples. The rate of production of the centers responsible for these resonance signals is comparable to the production rate of those centers which are responsible for the resonance signal in the intrinsic samples. Microfilm \$2.50; Xerox \$5.80. 117 pages.



SOME EFFECTS OF SMALL ADDITIONS  
OF COBALT OXIDE ON MAGNETIC PROPERTIES  
OF NICKEL AND NICKEL-ZINC FERRITES

(L. C. Card No. Mic 60-4251)

Harry Frederick Remde, Jr., Ph.D.  
Rutgers University, 1960

Major Professor: Professor John H. Koenig

Permeability and loss spectra for a large series of nickel-zinc-cobalt ferrites are given for frequencies from 1 Mc/s to 20 kMc/s. For frequencies up to 480 Mc/s, three-dimensional diagrams are shown from which the complex initial permeability  $\mu^* = \mu' - j\mu''$  may be read as a function of frequency, composition and fraction of theoretical density. Tables and charts for  $\mu Q$  product are supplied which can be used to find the optimum ferrite at a particular frequency.

The magnetic data indicate that wall movement occurs in all the compositions although domain rotation appears to play the larger part in the spectra when crystalline anisotropy is low. The broad loss spectrum found in nickel ferrite between 50 and 500 Mc/s is sometimes resolved into two loss maxima. The action of cobalt is to suppress the lower-frequency part of the loss spectrum and to increase the frequency of the remainder of the loss spectrum.

Application of the equation of a domain wall to the data indicates that the lower-frequency portion of the loss, which is eliminated by cobalt, may be due to wall movement inside small, nearly-perfect regions or grains.

Measurements between 3 and 20 kMc/s indicate that the spin resonance frequency of nickel-cobalt ferrite increases with cobalt content in a manner predicted by theory. The resonance peak lies between frequency limits of  $(\gamma/2\pi) H_A$  and  $(\gamma/2\pi) (H_A + 4\pi M_s)$  where  $H_A$  is the internal field due to crystalline anisotropy and  $M_s$  is the magnetization. A geometrical mean frequency  $(\gamma/2\pi) H^{1/2} (H_A + 4\pi M_s)^{1/2}$  fits the location of the loss maximum fairly well.

Microfilm \$2.50; Xerox \$7.80. 167 pages.

PHOTOCONDUCTIVITY IN POTASSIUM BROMIDE  
CONTAINING F CENTERS

(L. C. Card No. Mic 60-3987)

John Kenneth Robe, Ph.D.  
University of Illinois, 1960

Photoconductivity in potassium bromide containing F centers has been investigated at 80°K and at 18°K. Photocurrents have been measured over the spectral range from 2 to 5.6 eV, with F center concentrations between  $1.4 \times 10^{15}$  and  $6 \times 10^{17} \text{ cm}^{-3}$ . A recent examination of the F center absorption spectrum has shown that the high energy tail of the spectrum above the F and K bands contains three small bands, the  $L_1$ ,  $L_2$  and  $L_3$  bands. These three bands are clearly identified in the photocurrent data at 80°K and at 18°K. It is assumed, therefore, that the optical absorption responsible for the  $L_1$ ,  $L_2$  and  $L_3$  bands leads to the production of electrons in the conduction band at arbitrarily low temperatures.

The product of the quantum yield and the range per unit field has been measured at constant temperature for each crystal as a function of the incident photon energy. Using a value for the quantum yield in the F band obtained by other investigators (.02 at 80°K), the data obtained in this experiment is compatible with values for the quantum yield of the L bands between 0.2 and 1.0. However, if the apparent variation with F center concentration of the quantum yield in the L bands is due to impurities, the crystals containing the higher F center concentrations are less affected by the impurity and provide a more reliable value for the quantum yield. The weight of the evidence, therefore, is such that the quantum yield is unity.

At 18°K, the product of the quantum yield and unit range for a given wavelength and F center concentration is twice that found at 80°K. This change is attributed to a change in the unit range, which implies that the quantum yield for the L bands is also unity at 18°K.

Microfilm \$2.50; Xerox \$3.80. 66 pages.

SUPERCONDUCTIVITY IN SMALL SYSTEMS

(L. C. Card No. Mic 60-3989)

Kendal True Rogers, Ph.D.  
University of Illinois, 1960

An account is given of several calculations in superconductivity applying the microscopic theory to predict responses of small systems to externally applied currents and fields. By small is meant a size of order or smaller than the penetration depth.

Listing the calculations reported, there are (1) magnetic susceptibilities (small field limits) of thin films and small spheres treated according to London theory and Pippard theory (with parameters being interpreted through the microscopic theory), (2) critical currents in thin films or cylinders treated by a "semi-phenomenological" method and by a straightforward application of the microscopic theory, and (3) total magnetization curves and critical fields for spheres and cylinders treated by methods somewhat analogous to those of (2). Comparison with experiment is made in each of these cases but it may be noted that in very few cases are experimental sizes small enough for valid comparisons actually to be made.

Now, in more detail, the treatments (1) for magnetic susceptibilities of small samples are done by older techniques (of Schrieffer and Whitehead) with, however, parameters entering into the treatments being interpreted through the microscopic theory. The results obtained indicate (a) the predictions of the Pippard theory (random scattering) are in good agreement with Lock's experiments for his thickest samples, (b) all of the treatments are in poor agreement with Lock's results for his thinnest samples with the measured susceptibilities being anomalously large and decreasing considerably less rapidly (as sample size decreases) than any prediction, and (c) Pippard's theory is in fair agreement with Whitehead's experimental results employing colloidal suspensions of mercury.

Two ways of calculating (2) critical currents are presented. The first is a "semi-phenomenological" way in which (a) statistics of the superconducting state are assumed unchanged, (b) the energy gap is allowed to vary

with current (or with field in (3)), and (c) Pippard's infinite coherence limit is assumed. This treatment has an advantage over the microscopic treatment in that it should be more realistic as concerns electron scattering at a free boundary. The technique involved is to add a phenomenologically obtained energy associated with current flow to the microscopic theory's free energy and minimize with respect to the energy gap. A critical current as a function of temperature is obtained.

The second way of calculating a critical current is by straightforward extension of the microscopic theory in which (a) statistics of the current carrying state depend implicitly on the current, (b) the energy gap varies with current, and (c) London's limit of coherence is, essentially, assumed. The advantage here is that a more basic approach is taken in handling the problem but the scattering assumption is that of specular scattering. This assumption is probably unjustified experimentally.

The results obtained by either method agree in orders of magnitude with experimental results (within uncertainties introduced by difficulties of estimating sample sizes and geometries) but disagree in qualitative form near the critical temperature. The results obtained in the latter limit agree with one another (and with Ginzburg and Landau theory predictions) in the current dependence on temperature but most experiments disagree with these and are inconsistent among themselves. Several possibilities are mentioned for explaining the contradictions.

Somewhat analogous calculations are reported for (3) magnetizations of spherical and cylindrical samples. The types of experiments available with which the predicted magnetization curves are to be compared seem, inevitably, to involve a wide distribution of particle sizes. When the results obtained here are averaged over the size distribution appropriate to Whitehead's colloidal suspension, reasonable magnitudes and shapes are obtained for comparison with the magnetization curves measured experimentally. But it seems hardly possible to discriminate among theories under these circumstances.

Microfilm \$2.50; Xerox \$5.60. 112 pages.

#### PURE QUADRUPOLE RESONANCE IN INDIUM METAL

(L. C. Card No. Mic 60-3995)

William Walter Simmons, Ph.D.  
University of Illinois, 1960

The nuclear quadrupole resonance spectrum of indium metal has been observed and studied over the temperature range 4---225°K. There are four distinct resonant frequencies, always occurring in the frequency ratios 1:2:3:4, in agreement with the axially symmetric crystal structure possessed by indium. The lowest transition occurs at 1.881 mc/sec at 4.2°K. The quadrupolar coupling constant at this temperature is found to be  $(45.19 \pm .02)$  mc/sec. The line breadth of 80 kc/sec is approximately the same for all transitions, and shows essentially no change over the entire temperature range. All lines are Gaussian in shape. The average thermal coefficient of frequency between 4 and 77°K is found to be  $6 \times 10^{-4} (^\circ\text{K})^{-1}$ .

The large breadth of the resonance lines is phenom-

logically accounted for by a combination of pseudo-exchange and pseudo-dipolar mechanisms. A derivation of the Gaussian line shape and second moment is given in the approximation that the broadening mechanisms may be represented in the form  $A_{ij}I_{iz}I_{jz}$ . The axial component of the field gradient is calculated on an ionic core model by two methods. The first is a direct sum over all ionic cores within a sphere of radius much greater than the lattice distance. Exceedingly slow convergence is found. The second method involves a multipole expansion of the field gradient produced by conduction electrons plus ionic cores. This method depends upon charge cancellation for distances far from the origin for convergence. Therefore the convergence is much better, giving agreement with the result of the first method within 10% for the first three nearest neighbor groups only. Both calculations lead to a quadrupolar coupling constant which is too low by approximately a factor of 3, indicating that p-electrons in the conduction band influence the field gradient appreciably. A detailed band theory calculation would be necessary to accurately assess this contribution.

Similarly the temperature dependence is large and cannot be accounted for on an ionic core model, even when anisotropy of the thermal expansion coefficients is explicitly considered. The dependence of the field gradient on lattice modes of vibration is shown to be relatively small.

An observation of the pure quadrupole resonance in the superconducting state is reported. Its frequency is shifted downwards from the normal state frequency by approximately 2%. This value is very uncertain. No explanation of the size of this shift is apparent.

All experimental results were taken with a variable frequency RF spectrometer and by conventional nuclear magnetic resonance techniques. The spectrometer is described briefly.

Microfilm \$2.50; Xerox \$6.00. 122 pages.

#### THE ELASTIC AND PLASTIC PROPERTIES OF ZINC AND CADMIUM WHISKERS

(L. C. Card No. Mic 60-4619)

Malcolm John Skove, Ph.D.  
University of Virginia, 1960

The elastic and plastic properties of single crystal whiskers of zinc and cadmium were investigated and the results reported. These whiskers were investigated because it was thought that the reasons for the high elastic strains to which they may be submitted needed further elucidation.

The properties of these whiskers in the elastic region were investigated from two approaches. The first was to determine the linearity of the stress-strain relation to 2% longitudinal strain; that is, to determine if Hooke's law is valid to 2% strain. To this end a testing machine was constructed that was capable of detecting extensions of the sample as small as 0.01 micron. This gave an accuracy of 1% in the measurement of the extension of the smallest sample used. The result of forty experiments was that Hooke's law is valid to 2% strain in zinc and cadmium. The second approach was to determine the temperature



dependence of the yield point. The testing machine was constructed so that a whisker could be tested while it was immersed in a constant temperature bath. These experiments showed that the elastic limit of whiskers increases with decreasing temperature. The results were compared with the theory of nucleation of dislocations in a perfect lattice, and it was concluded that the whiskers contain imperfections which cause stress concentrations. Several modifications of the theory which would take into account the imperfections of the whisker were examined in a qualitative fashion, and it was concluded that nucleation probably occurred at surface imperfections.

The plastic properties of these whiskers are also of interest as it is believed that the whiskers may be initially dislocation-free. The plastic deformation is initiated in a small region of the whisker when the whisker yields, and further stressing causes this region to propagate along the whisker.

The deformation is caused by a single slip system, the [1120]/(0001) system. The propagation of the deformation implies that the [1120] dislocations of this system cross-slip into neighboring planes. The temperature dependence of the stress necessary to propagate the deformation was measured with the testing machine mentioned above, and it was found that the stress was independent of temperature within the experimental accuracy which was, however, quite large due to the variation of the propagation stress as the deformation band progressed along the whisker. This result implies that the activation energy for cross-slip is quite small, in contrast to the results previously inferred from experiments on bulk single crystals of zinc.

Microfilm \$2.50; Xerox \$3.60. 62 pages.

#### ELECTRICAL PROPERTIES OF METAL WHISKERS

(L. C. Card No. Mic 60-4624)

Ephraim Posey Stillwell, Jr., Ph.D.  
University of Virginia, 1960

By comparison of the electrical resistivities of metal whiskers of copper, silver, zinc and cadmium to the resistivities of the pure crystals it has been shown that these whiskers have residual resistivities of from one to twenty percent of the resistivities at zero degrees centigrade. The primary cause of the residual resistivity in the copper whiskers grown by reduction of copper iodide or copper bromide vapor has been shown to be impurities in the crystal and the impurities were iodine and bromine respectively. The concentration of impurities has been shown to be from one to ten impurity atoms in tenthousand.

A study of the effect of elastic strains up to one percent has been made on zinc and cadmium whiskers and the presence of large second order effects has been established. The linear strain-resistivity coefficients agree with those obtained by other workers using bulk crystals. These coefficients have been used in conjunction with Bridgeman's data from hydrostatic pressure experiments to determine the strain-resistivity tensor for zinc. A further study of the effect of temperature variation on the strain-resistivity coefficients has been made.

A mode of twinning has been observed for zinc whiskers

oriented with an a vector perpendicular to the whisker axis. The twinned crystals exhibited elastic behavior and usually yielded at about six-tenths percent strain.

The apparatus used for making these measurements is described. Microfilm \$2.50; Xerox \$4.00. 71 pages.

#### DIELECTRIC LOSSES RESULTING FROM DISLOCATIONS IN SAPPHIRE

(L. C. Card No. Mic 60-3713)

Norman M. Tallan, Ph.D.  
State University of New York,  
College of Ceramics at Alfred University, 1959

When the dielectric loss of Linde flame-fusion grown clear sapphire was studied at frequencies between  $10^2$  and  $10^4$  cps and temperatures between  $-160$  and  $400^\circ\text{C}$ , dielectric loss maxima were observed. The loss peaks were more pronounced with the optic axis parallel to the applied field than with it perpendicular to the field. With careful balancing of the bridge-guard circuit system used, no significant conduction loss was observed in the temperature range studied.

The temperature dependence of the frequency corresponding to the loss maxima observed was found to obey an expression of the form

$$\frac{1}{\omega_{\max}} = Ae^{B/T}.$$

On the assumption that the specific form of this expression is

$$\frac{1}{\omega_{\max}} = \tau_0 e^{H/kT},$$

values of the activation energy,  $H$ , and the time constant,  $\tau_0$ , were calculated for each set of experimentally obtained loss curves.

The value of  $H$  was found to decrease with heat treatment at  $400^\circ\text{C}$  while the value of  $\tau_0$  increased under these conditions. When the sample was exposed to hydrogen as the dry gas, a dilute acid, or a moist atmosphere,  $H$  was found to increase and  $\tau_0$  to decrease. The variation of  $H$  appeared to be between upper and lower limits of approximately 0.5 and 0.3 eV respectively, whether the variation was produced by heat treatment or exposure to hydrogen.

Several possible mechanisms are discussed which might explain this behavior of the dielectric loss. Objections are raised to analyses of the loss behavior on the bases of relaxation of permanent dipoles, resonance of bound charges, and the hindered movement of ions on lattice tunnels.

It is suggested that hydrogen enters the crystal lattice along dislocations and is bound to them within the regions of dilational strain near them. A model is proposed for the position and behavior of this hydrogen within the crystal lattice. It is suggested that the hydrogen contributes electrons to the locally warped conduction band in the lattice near the dislocations and that the resulting hydrogen ions are bound to equilibrium sites between oxygen ions.

The behavior of the loss maxima upon heat treatment or exposure to hydrogen is explained on the basis of

dielectric losses arising from the presence of semiconducting regions within the otherwise insulating solid. The decrease in  $H$  upon heat treatment and increase upon exposure of the sample to hydrogen is attributed to changes in the energy gap between donor levels and the conduction band resulting from changes in the lattice strain near the dislocations under these conditions. The increase of  $\tau_0$  upon heat treatment and decrease upon exposure to hydrogen is attributed to changes in the concentration of hydrogen in the semiconducting regions under these conditions. The observed limits on the variation of  $H$  were associated with the expected bounds on the radius of the Cottrell atmosphere surrounding a dislocation under the conditions of the investigation.

An empirical expression was presented to represent the temperature dependence of the dissipation factor in the vicinity of a loss maximum when a distribution of conductivities for the semiconducting regions is present. It was shown that a typical loss maximum observed experimentally fits the presented expression extremely well and that the value of the single empirical constant required for this fit indicates that a broad distribution of conductivities is actually present in the samples studied.

Microfilm \$2.50; Xerox \$8.60. 187 pages.

#### GROWTH AND SEMICONDUCTING PROPERTIES OF GRAY TIN SINGLE CRYSTALS

(L. C. Card No. Mic 60-4804)

Obert Norman Tufte, Ph.D.  
Northwestern University, 1960

Supervisor: Dr. A. W. Ewald

A method of growing single crystals of gray tin from a mercury solution is described. Single crystals having

dimensions of the order of 1 cm have been grown. The results of low temperature Hall effect measurements indicate the mercury grown crystals contain approximately  $10^{17} \text{ cm}^{-3}$  n-type impurities and are as pure as the white tin from which they are grown. Methods for obtaining single crystals of certain gray tin alloys are also described.

The electrical conductivity, Hall effect and magnetoresistance are measured as a function of temperature for both p and n-type single crystals and these results are compared with the previously reported results for polycrystalline material obtained by the usual phase transformation. At 77°K the purest single crystals have an electron mobility of  $1.6 \times 10^5 \text{ cm}^2/\text{volt-sec}$  which is considerably higher than the previously reported values.

The band structure of gray tin is investigated using the magnetoresistance method. Magnetoresistance measurements are made on oriented n and p-type single crystals at 77°, 195° and 273°K. From these measurements, the low field magnetoresistance coefficients are evaluated. Using these coefficients, and assuming the scattering of charge carriers from ionized impurities is anisotropic, it is concluded that the surface of constant energy in the conduction band are ellipsoids of revolution located along the [111] axes. An effective mass ratio of 2.4 is calculated from the magnetoresistance coefficients at 273°K. It is also concluded that the surfaces of constant energy in the valence band are approximately spherical.

Microfilm \$2.50; Xerox \$5.00. 97 pages.

#### PHYSIOLOGY

#### ELECTRICAL PROPERTIES OF MUSCLE MEMBRANE OF THE MUSSEL, MYTILUS EDULIS.

(L. C. Card No. Mic 60-3887)

Charles Henry Cappel, Ph.D.  
University of Illinois, 1960

The passive electrical properties of the muscle membrane of the anterior byssus retractor muscle of Mytilus edulis were investigated by means of external electrodes, and the membrane constants calculated by the equations of core conductor theory, using the method of Hodgkin and Rushton. Fiber bundles of 0.2 to 0.5 mm diameter were employed. The membrane constants in sea water were: space constant, 2.36 mm; time constant, 92 msec; resistivity of myoplasm, 112 ohm cm; membrane resistance, 61,400 ohm  $\text{cm}^2$ ; membrane capacity, 3.3  $\mu\text{F}/\text{cm}^2$ . Resistance increased to 99,300 ohm  $\text{cm}^2$  in potassium-

deficient medium and decreased to 20,000 ohm  $\text{cm}^2$  in potassium-rich medium; it was 32,900 ohm  $\text{cm}^2$  in low NaCl medium. The calculations are based on an assumption of uniform fiber size of 5 micra diameter. The constants varied considerably from specimen to specimen.

The membrane is a good electrical rectifier, resistance to outward (depolarizing) currents being less than to inward currents. At higher stimulus intensity delayed rectification occurs. In potassium-rich medium a "minor reversal" of rectification may occur, that is, resistance under the cathode increases with small currents, then decreases with larger currents, resulting in a sigmoid curve. In  $\text{K}_2\text{SO}_4$ -sucrose solution complete reversal was obtained, that is, resistance to outward currents was greater than to inward currents over a large range.

Only electrotonic potentials could be demonstrated in most of the small bundle preparations. The muscle membrane was considered to be electrically inexcitable, at least under these conditions. Muscle action potentials



could be obtained with nerve-muscle preparations; these potentials could be blocked with the anticholinergic drug Banthine and seemed insensitive to sodium-deficiency under the conditions of the experiment (agar-sea water electrodes). Magnesium-deficiency favored action potentials; excess magnesium blocked them. Occasionally action potentials could be obtained in small bundle preparations, but the conditions for their appearance could not be ascertained. Magnesium-deficiency and excess potassium favored their appearance. The membrane of this muscle appears to be unusual in its high membrane resistance and its sensitivity to magnesium. It appears similar to other membranes in its potassium effects. Other ionic effects require further study.

Microfilm \$2.50; Xerox \$4.80. 94 pages.

#### DEVELOPMENT OF CONTRACTILE ACTIVITY IN FROG STRIATED MUSCLE

(L. C. Card No. Mic 60-3891)

Russell Ian Close, Ph.D.  
University of Illinois, 1960

In the frog sartorius muscle the onset of the active state occurs not later than 10 milliseconds after the stimulus at 0°C. The intensity increases with time in a sigmoid fashion and the fully active state is attained about 40 milliseconds after the stimulus. The time course of the development of the active state is dependent upon the intensity of the active state existing at the time the stimulus is given.

The speed of shortening in the absence of a load appears to be the same in the partially developed and fully active states, but for loads up to isometric conditions the speed of shortening is dependent upon the intensity of the active state.

The nitrate ion retards the development of tension during the early part of the contraction phase of the twitch; presumably by slowing the development of the active state. Later in the contraction phase the tension is augmented by the nitrate ion due to prolongation of the active state. These effects are maximal within a few minutes after addition of the ion and they are probably mediated at the surface of the muscle fiber.

The force:velocity relations of the muscle in the partially active state indicate that the rate of activation of a whole sarcomere is dependent upon the rate of propagation inwards of the transverse component of the processes which connect excitation and contraction.

Microfilm \$2.50; Xerox \$3.80. 66 pages.

#### ELECTROLYTE ANALYSES OF CHICK EMBRYONIC VENTRICLE TISSUE AND OF CELLS CULTURED FROM SUCH TISSUES

(L. C. Card No. Mic 60-4236)

Mary Harsch, Ph.D.  
Rutgers University, 1960

Major Professor: Dr. James W. Green

The sodium and potassium content of 5-6, 8, 11, 12, 15 and 18 day old embryonic and post-hatched chick ventricular tissue decreased with embryonic age until the 18th day and increased after hatching. The chloride content of 8, 11, and 18 day old ventricle tissues also decreased with embryonic age.

Sodium, potassium and chloride values from 8, 11 and 18 day old ventricle embryonic tissues rinsed briefly in isotonic sucrose were lower than corresponding values from unrinsed tissues. These differences could not be attributed to retention of blood by unrinsed tissues.

Tissue culture cells placed in isotonic sucrose ceased contracting with no apparent change in volume.

Sodium and potassium analyses were performed on 7 day old single-cell cultures prepared from 8 day old trypsinized chick embryonic hearts. By varying the exposure of trypsinized cells to glass surfaces the composition of the cultures was varied from (1) primarily fibroblasts, (2) fibroblasts and muscle cells, and (3) chiefly muscle cells. The ion content per wet weight of packed cells was low. This indicated that a loss of cellular ion content probably occurred when the cell cultures were prepared or when the cells were harvested from cultures.

The assumptions were made that the percent sodium concentration of the total sodium and potassium concentration of the packed cells was valid, and that the sum of the sodium and potassium within a kilogram of cells and in a liter of medium were equal. This latter assumption was supported by the close agreement between the sum of the sodium and potassium concentrations from the intracellular tissue and from the extracellular tissue spaces of ventricular tissue. On the basis of these assumptions "calculated" sodium and potassium concentrations were obtained for cultured cells. These values could not be compared with those from ventricular tissues as the former represented intracellular ion concentrations of cultured cells and the latter the sum of the ion content contributed to by intracellular tissues and extracellular tissue spaces of ventricle tissues.

Inulin measurements of extracellular tissue space of 8, 11 and 18 day old embryonic ventricular tissue, and sodium, potassium and chloride analyses from amniotic fluid (8 and 11 day old embryos) and from blood plasma (11 and 18 day old embryos) permitted calculation of the ion composition of extracellular fluids from 8, 11 and 18 day old tissues. A significant difference was found between the extracellular space of 8 and 18 day old tissues and between specific ion concentrations of amniotic fluid and plasma from 11 day old embryos.

Averaged values for extracellular space, for ion concentrations of amniotic fluid, plasma and ventricular tissues were used to calculate the intracellular ion concentrations for 8, 11 and 18 day old tissues. The trends

for the intracellular sodium and potassium values were in the same direction but opposite to that for the amniotic fluid and plasma over corresponding periods of time. The chloride trends were in the same direction. A high intracellular chloride was found.

The "calculated" sodium content of the cultured cells was higher than, and the potassium content similar to that of ventricular intracellular tissue. The scatter of these "calculated" values prevented an ionic differentiation of fibroblasts from muscle cells as well as a correlation of cell cultures with ventricular tissue of definite embryonic age. Microfilm \$2.50; Xerox \$6.60. 137 pages.

#### EFFECTS OF IMMERSION IN WATER ON THERMAL SWEATING

(L. C. Card No. Mic 60-4420)

Bruce A. Hertig, Sc.D. Hyg.  
University of Pittsburgh, 1960

Studies on human volunteers immersed to the neck have revealed that sweating in a bath is influenced by time of immersion as well as by level of thermal stress. When stress was maintained at a constant level, sweating declined markedly from the peak rate reached in the first hour of exposure.

Numerous three- and four-hour exposures showed that this characteristic time-course of response occurred irrespective of state of acclimatization, level of bath temperature, activity, or changes in body temperature.

When sweat rate was plotted as a function of time on semi-logarithmic coordinates the data suggested a two component system: thermal stimulation of sweat according to the function:  $S = C(1 - e^{-kt})$  upon which was superimposed the decline,  $S = S_0 e^{-k't}$ . The time constant  $k$  was an order of magnitude larger than  $k'$ .

Presoaking in thermally neutral water proved that the decline was independent of prior activity of the sweat glands; i.e., the rate of sweating was suppressed equally at a given point in time of the exposure whether the first hours of the exposure were in thermally neutral water (sweat glands inactive) or in hot water (sweat glands active). These findings are inconsistent with the concept of "sweat gland fatigue" in which decline of sweating is attributed to inability of the glands to maintain a high secretory rate over a prolonged period.

Addition of salt to the bath water in increasing amounts decreased the extent to which sweating declined. When the concentration was 15 per cent NaCl (by weight) sweating did not decline at all. Inasmuch as this concentration has been shown by others to prevent inward diffusion of water, several mechanisms by which water absorption could affect sweating were considered. The data indicated that a total of about 30 to 50 grams were absorbed by the corneum and all in the first half hour of exposure. Calculations utilizing published values for the diffusivity of human skin showed the inward diffusion to the deep skin to be on the order of 10 to 15 g/hr.

Mechanical occlusion of the sweat duct by swelling of the horny layer did not appear to offer an acceptable explanation for the decline of sweating. The time-course of absorption by the corneum did not agree with the time-

course of decline. Further, no miliaria was observed, contraindicating retention of sweat.

Considering (1) that glandular fatigue, changes in body temperature and mechanical suppression failed satisfactorily to account for the observed decline, and (2) that decline was apparently associated with pressure for diffusion, it was concluded that the small amounts of water diffused into the deep skin progressively altered the thermal or biochemical properties of the tissues, reducing or inhibiting stimulation of the sweat glands.

The results of this study offer an attractive explanation for the observation by several authors that sweating declines more in hot-humid than in hot-dry environments. In the former, excess sweat provides ample opportunity for soaking of the skin. It is suggested that the extra decline in hot-humid air environments may be better ascribed to skin wetness than to glandular fatigue.

Microfilm \$2.50; Xerox \$5.60. 111 pages.

#### EFFECT OF AUTOTRANSPLANTATION OF THE HYPOPHYSIS ON ITS FUNCTIONAL INTEGRITY

(L. C. Card No. Mic 60-3952)

Robert Chueng-Shyang Ma, Ph.D.  
University of Illinois, 1960

The effects of hypophysectomy and autotransplantation of the pituitary gland into the kidney capsule on pituitary dependent endocrine glands, were investigated in four experiments during which the operated birds were killed at various intervals after initial surgical intervention. The criteria used to study the biological activity of the end-organ glands following initial surgery included their weights, histology, and ability to take up I-131 or P-32 as well as the determination of the ascorbic acid content in case of the adrenal gland.

The general conclusions reached were that hypophysectomy leads to a rapid and complete degeneration of testes, combs, and thyroids, as well as having a profound effect on the molting pattern and the morphology of the feathers of these birds. In the group with autotransplanted pituitary glands, the testes and combs degenerated completely. The thyroid glands, however, apparently retained their ability to function at a level somewhat below that of intact control animals. That the thyroid function was not disturbed too much is seen from the fact that neither the molting pattern nor the feather morphology were altered significantly in the autotransplanted group. Similarly, the thyroids of cockerels in the autotransplanted group retained their ability to take up I-131 and P-32, while the thyroids of hypophysectomized animals were markedly less active in these respects.

Of special interest are the effects of hypophysectomy or of autotransplantation on the biological activity of the adrenal glands in comparison to the biological activity of adrenals of normal control birds. It was found that the adrenals in the two surgically operated groups were usually heavier, and that their histological appearance was not significantly different from that of the controls.

The adrenal glands of both operated groups took up significantly more P-32 than did the adrenals of normal



controls. For reasons which are discussed in detail in the body of the thesis, it is felt that this indicates that in chickens there may be an extra-hypophyseal source of ACTH, or that the adrenal glands in birds are generally independent from the adenohipophysis for hormonal support.

These observations suggest that the adrenals in both autotransplanted and hypophysectomized birds retain their quantitative ability to function, but they apparently function at qualitatively different levels. This is shown in differences in mortality rates. There is no difference between the two groups in post-surgery mortality during the first five days. Following this initial mortality, animals with autotransplants are well able to withstand stress and live as well as control birds, while hypophysectomized animals are not, and continue to die throughout the whole experimental period.

Microfilm \$2.50; Xerox \$4.60. 86 pages.

#### HYALURONIDASE AND ITS FUNCTION IN THE AMERICAN COCKROACH, PERIPLANETA AMERICANA (L.).

(L. C. Card No. Mic 60-4264)

Donald James Sutherland, Ph.D.  
Rutgers University, 1960

Major Professor: Dr. Andrew J. Forgash

Tissues of the American cockroach yield a product which is relatively low in hyaluronidase activity, when such tissues are treated by methods employed for the purification of testicular hyaluronidase. Although higher in hyaluronidase activity than products from whole cockroaches, the products extracted from salivary glands were only approximately 1/60 as active as the testicular hyaluronidase preparation used (Wyeth, 650 T.R.U./mg.).

The activity of cockroach hyaluronidase, at the stage of purity tested, was not affected by sodium chloride, potassium chloride, and gelatine. The enzyme was inactive against unbleached chitin and chondroitin sulfate A from bovine nasal septa.

Histochemical methods, based on the adsorption of ferric ions and their subsequent conversion to Prussian blue, failed to indicate the presence of substrates of testicular or cockroach hyaluronidase in the cockroach alimentary canal and salivary glands.

Two aminopolysaccharide fractions, similar in composition to hyaluronic acid and chondroitin sulfates A, B, and/or C, were extracted from the meat meal component of cockroach laboratory diet (Purina Dog Checkers). Testicular and cockroach hyaluronidase depolymerized the non-sulfated fraction completely. The sulfated fraction was depolymerized incompletely by the testicular enzyme and only slightly by the cockroach enzyme.

When cockroaches were fed a diet of Purina Dog Checkers plus crude hyaluronate for 7 days, hyaluronidase activity in the salivary glands and the alimentary canal

decreased below that of cockroaches fed Purina Dog Checkers, dextrose, or vitamin-free casein. There was evidence that the secretion of hyaluronidase from the salivary glands was dependent on the type of food ingested. On the basis of (1) the activity of cockroach hyaluronidase against aminopolysaccharide fractions from meat meal, and (2) the effect of additional dietary hyaluronate upon enzyme activity, it is concluded that the function of cockroach hyaluronidase is, at least in part, digestive.

When cockroaches were maintained for extended periods on Purina Dog Checkers or potato, the presence and activity of hyaluronidase were independent of type of diet. Cockroaches obtained from nature contained hyaluronidase in amounts comparable to that present in the laboratory strain. Although cockroaches in the wild have access probably to diets containing varying amounts of hyaluronic acid, it appears that the constant use of hyaluronate-containing diet has not been selective for increased hyaluronidase activity in the laboratory strain of cockroaches.

A potent hyaluronidase was found to occur in an abdominal homogenate of cicada killers, *Sphecius speciosus* Drury. The venom is the probable source of the enzyme.

Extracts from other insect species representing the orders Lepidoptera, Plecoptera, Hymenoptera, and Orthoptera, could not be purified sufficiently to be assayed properly for hyaluronidase activity.

Microfilm \$2.50; Xerox \$5.20. 103 pages.

#### FEEDING AND GROWTH ON SOLANACEOUS AND NON-SOLANACEOUS PLANTS BY NORMAL AND MAXILLECTOMIZED LARVAE OF THE TOBACCO HORNWORM, PROTOPARCE SEXTA (JOHAN.), (LEPIDOPTERA, SPHINGIDAE).

(L. C. Card No. Mic 60-4010)

Gilbert Peter Waldbauer, Ph.D.  
University of Illinois, 1960

Tobacco hornworm larvae normally feed on Solanaceae, but will occasionally accept allies of the Solanaceae, some Compositae and a few others when starved. The adaptability of normal larvae to a non-solanaceous plant, *Verbascum thapsus*, varied with age, increasing from the first to the third instar but decreasing through the fourth and fifth instars.

Preliminary experiments showed that maxillectomized tobacco hornworm larvae as well as silkworm larvae would feed on plants which were normally rejected by intact larvae. The antennae, maxillae and labial palpi of tobacco hornworm larvae were amputated in all possible combinations. Operations including the removal of the maxillae resulted in extensive and continuous feeding on *Taraxacum officinale*. However, amputation of the antennae and/or the labial palpi in addition to the maxillae did not enhance feeding on *T. officinale*. The third

segments and the headpieces of the maxillary palpi were amputated alone and in combination. The removal of both abolished the response to the feeding deterrent(s) in *T. officinale* within twenty-four hours. The removal of the third segments had no effect and the removal of the headpieces alone abolished the response after seventy-two hours. The sensilla of both structures are sensitive to the deterrent(s), but those of the headpieces evidently have a lower threshold for response.

Maxillectomized larvae became adapted to the taste of *T. officinale* and preferred it to tomato when given a choice. Recognition was evidently mediated by gustatory receptors on the hypopharynx and perhaps the epipharynx.

It is likely that the maxillae spontaneously inhibit feeding when the concentration of token feeding stimulants or sapid nutrients is below optimum. Synthetic media (agar, agar and cellulose powder, cellulose powder and water, and gelatin and cellulose powder) which apparently lack either feeding stimulants or deterrents were more acceptable to maxillectomized larvae than to normal larvae. Synthetic media with the optimum concentration of glucose were equally acceptable to normal and maxillectomized larvae. Maxillectomized larvae did not eat more tomato leaves than did normal larvae.

Of thirty-six non-solanaceous plants fourteen were refused by normal and maxillectomized larvae, nine were

eaten slightly by maxillectomized larvae and thirteen, mostly Compositae or allies of the Solanaceae (Convolvulaceae, Verbenaceae, Scrophulariaceae and Bignoniaceae), were highly acceptable to maxillectomized larvae and usually slightly acceptable to normal larvae.

Maxillectomized larvae grew on eleven non-solanaceous plants, with some surviving to the pupa on *Verbena urticifolia*, *Verbascum thapsus*, *Catalpa speciosa*, *Plantago rugelii*, *Arctium minus*, *Taraxacum officinale* and *Lactuca sativa*. A detailed study showed that the growth of fourth and fifth instar larvae on *T. officinale* was somewhat slower but otherwise comparable with growth on tomato. Mortality on *A. minus* was high; growth was extremely slow and usually involved an extra instar. Growth on *V. thapsus* was also very slow and invariably involved an extra instar. Few larvae survived.

The consumption index, the coefficient of digestibility and the efficiencies of conversion of ingested and digested food to body matter of maxillectomized, fourth instar larvae were determined on tomato, *T. officinale* and *A. minus*. Growth was slower on *T. officinale* and *A. minus* because the larvae ate less and digested less of what they ate. The coefficient of digestibility was about 48% on tomato, 39% on *T. officinale* and 35% on *A. minus*. Somewhat more than 50% of the digested food was converted to body matter in each case.

Microfilm \$2.50; Xerox \$6.60. 140 pages.



POLITICAL SCIENCE

POLITICAL SCIENCE, GENERAL

THE RIGHT OF SILENCE AND  
STATUTORY IMMUNITY: A STUDY OF THE  
PRIVILEGE AGAINST SELF-INCRIMINATION  
WITH PARTICULAR EMPHASIS UPON  
THE IMMUNITY ACT OF 1954.

(L. C. Card No. Mic 60-3567)

Richard John Bloss, Ph.D.  
University of Pennsylvania, 1960

Supervisor: Dr. Henry J. Abraham

The Fifth Amendment of the Constitution provides:

No person . . . shall be compelled in any criminal case  
to be a witness against himself . . .

The amendment thus appears to prohibit the use of  
compulsion by the government to obtain testimony. It does  
not suggest, much less provide for, a substitution of equal  
protection through a statutory enactment. Nevertheless,  
the federal government has provided, in several instances,  
such a statutory substitute. In most of these statutes,  
commonly referred to as "immunity laws" or "immunity  
baths," the protection granted to the witness in lieu of the  
privilege against self-incrimination is set down in these  
terms:

. . . no such witness shall be prosecuted or subjected  
to any penalty or forfeiture for or on account of any  
transaction, matter or thing concerning which he is so  
compelled . . . nor shall testimony so compelled be  
used as evidence in any criminal proceeding (except  
perjury or contempt prosecutions) against him in any  
court.

How should these competing interests of disclosure and  
silence be resolved? First, and foremost, this thesis  
represents an attempt to answer this question through an  
analysis of the origins and implementation of the Immunity  
Act of 1954. Second, in order to provide the proper setting  
for the analysis of the Act, the author seeks to establish  
the broad outline of the extent and adequacy of the protec-  
tion afforded to witnesses by the privilege against self-  
incrimination and statutory immunity.

Since the major concern of this study is with the legal  
status of the individual-state relationship, the investigation  
is primarily based upon an analysis of federal court deci-  
sions in immunity and self-incrimination cases. Other  
sources include the decisions of the lower federal courts,  
federal statutes, congressional reports and journals, state  
constitutions, and state court decisions. The methods used  
in resolving the basic problem are primarily critical and  
analytical as applied to the legislative and judicial decision-  
making process. The chapter headings are illustrative of  
the analytical approach to the problem: Chapter I, Intro-  
ductory; Chapter II, Origins of the Privilege Against Self-  
Incrimination and Immunity Statutes; Chapter III, The

Privilege Against Self-Incrimination - Claim, Scope and  
Waiver; Chapter IV, Immunity Statutes - Claim, Scope and  
Waiver; Chapter V, An Evaluation of the Immunity Act of  
1954 - Making Public Policy in Congress; Chapter VI, The  
Immunity Act of 1954 in the Courts; Chapter VII, Other  
Issues: Congressional Investigations, Separation of  
Powers, and Federalism; Chapter VIII, Conclusions.

The principal conclusions of this inquiry are: First,  
the common law and the historical origins of the privilege  
provide adequate evidence to support the right of silence;  
Second, although the constitutional prohibition against  
compulsion is clear, several restrictions upon the privi-  
lege already exist through judicial interpretations of con-  
structive waiver, compulsory waiver, bodily examinations,  
and the effects of the federal system; Third, the equal  
nature of the protection against self-incrimination pro-  
vided by immunity statute is more credible in theory than  
in substance; Fourth, an evaluation of the legislative  
enactment of the Immunity Act of 1954 reveals serious  
doubts about its moral, constitutional, and practical pur-  
poses; Fifth, an analysis of court tests of the Act reveals  
doubts of the adequacy of constitutional supports for the  
immunity statute; Sixth, a defense of an unfettered privi-  
lege against self-incrimination rests, in part, on a need  
to offset the lack of individual safeguards in congressional  
investigations; Seventh, judicial involvement in the dis-  
pensation of immunity grants under the 1954 Act endangers  
judicial independence in the separation of powers system;  
Eighth, in this area of inquiry federalism can be as great  
a hindrance to civil liberties as it is a support.

In line with the basic purposes of the study, it is dem-  
onstrated that only an unrestricted privilege can provide  
the constitutional protection of the right of silence in the  
Fifth Amendment. The author concludes that the Immunity  
Act of 1954 should be repealed.

The appendices contain the original federal immunity  
statute of 1857, its amendments, including the Immunity  
Act of 1954, and the application for the immunity order in  
the Ullmann case.

Microfilm \$3.40; Xerox \$11.95. 264 pages.

SUBHAS CHANDRA BOSE,  
BENGALI REVOLUTIONARY NATIONALIST,  
1897-1945.

(L. C. Card No. Mic 60-3022)

Robert Leroy Bock, Ph.D.  
The American University, 1960

Subhas Chandra Bose was a typical representative of  
the activist Bengali political tradition during the independ-  
ence movement in India through its years of fruition. He  
will probably be remembered best as Netaji or leader of  
the Indian National Army; consequently, he is designated  
as a revolutionary nationalist. He gave evidence of

constructive administrative abilities during the years when he served in various Bengali elected offices as well as throughout his administration as President of the Congress Party, and finally in his leadership role as head of the "national army" and of a "provisional government."

Although the Indian National Army was essentially a part of the Japanese military effort, it was also a factor of some importance in hastening the end of the British imperial control of India. Its psychological and propagandistic effects and impacts alone, at the time of the I. N. A. trials near the end of 1945, had a significant, if not determinate impact upon the British in their decision to transfer power in India.

In dealing with the activist Bengali political tradition which Subhas Chandra Bose represented and in which he was a leader during the twenty years prior to his death in 1945, his political career has been presented chronologically and biographically. Bose's political ideas were shown to be emotional and eclectic, opportunistic and expedient, completely channeled into the national independence movement. His political philosophy was sprinkled with fascist and communist ideas, with admiring references to such nationalists as Mustapha Kemal Ataturk and Eamon de Valera, and included as well, many liberal ideas derived from traditional Anglo-Indian moderate and progressive sources. He also spoke well of Roosevelt's New Deal.

The major problem was examining Bose's nationalistic ideal of how India could achieve independence and interpreting the varying and sometimes conflicting ideas which made up his "philosophy." Primarily, Bose's career, and its influence and impact, were emphasized and shown to be predominantly activist and immediate rather than philosophical. Although both democratic and dictatorial in different phases of his career, Bose's Axis-alliance fixed him rather irretrievably as a symbol of totalitarian dictatorship. In fact, his extremist leadership against imperialism marked him as the most popular would-be dictator India has yet known.

Microfilm \$3.70; Xerox \$13.05. 286 pages.

**FRENCH CATHOLICISM ON THE THRESHOLD  
OF THE FIFTH REPUBLIC: A SURVEY OF  
POLITICALLY-SIGNIFICANT CATHOLIC GROUPS  
AT A TURNING POINT IN FRENCH HISTORY.**

(L. C. Card No. Mic 60-4965)

William Arthur Bosworth, Ph.D.  
Princeton University, 1960

The chief aims of this thesis are to evaluate the politically-significant activities of present-day French Catholic groups, and through this evaluation to clarify the way in which "French Catholicism" may be considered a single, coordinated entity in French political life. The political crisis of 1958 forms one background against which the ideas and activities of clergymen, leaders and reviews of laymen's groups, independent Catholic publications, and to some extent individual Catholics, can be evaluated. Catholic reactions to other significant political questions are also considered -- notably, reactions to the problem of state aid to private schools.

Lay Catholic groups have been divided into three cate-

gories, according to their distance from the Church Hierarchy: nearest are Catholic Action groups, farthest are those of Catholic inspiration, and between the two are Catholic social action groups. A detailed consideration of Catholic laymen's groups shows that a great many have a significant political impact. For example, at the height of the school crisis in 1951, certain Catholic school pressure groups virtually dominated the National Assembly. In 1958, right wing extremist Catholic groups may have added to the political crisis. In recent years, the MRP seems to have attracted some of the Catholic Action-trained leaders who want to extend their religious principles into the political sphere. Finally, the CFTC, a group formally unrelated to the Church, adds to the political effectiveness of French Catholicism by instilling in large numbers of workers a more receptive attitude toward the Church and Catholic groups.

In theory, the Hierarchy possesses many controls over Catholic groups, and if it desired it could make many into simple agents for the Church in the political and social spheres. However, in practice French Catholic groups do not present a united front on any political or social question. One reason is the lack of political agreement within the Hierarchy itself. Also the Hierarchy learned in the crisis over Church-state separation a half-century ago that its direct partisan activity often had a minimal national impact and only stimulated reprisals from laic forces. Now the Hierarchy and most Catholic groups stress spiritual goals rather than coordination for political efficiency.

On any given political matter, lay groups are even more divided than the Hierarchy. There are at least four significant clusterings of Catholic groups, around the progressive-left, the moderate-center, the conservative, and the extremist-authoritarian political tendencies. Hardly any contacts exist between tendencies. Furthermore, the tendencies do not seem to be caused by religious differences; rather, they are reflections of differing class backgrounds or personal preferences.

If individual Catholics vary so much in their political views, why do they desire to remain together in Catholic organizations, rather than joining larger non-religious groupings of the same political color? A partial answer lies in the work of groups like Catholic Action, which try to make members think and act throughout their temporal life as "Catholics." The complete answer can be found only through more comprehensive research into the psychology of individual Catholics. At any rate, the existence of Catholic groups of varied political orientations shows that the common religious core of French Catholicism attracts individuals with widely-varying viewpoints. This is perhaps the most concrete social sense in which "French Catholicism" as a single entity exists.

Microfilm \$6.05; Xerox \$21.40. 475 pages.



ANALYSIS OF THE 1958  
CONGRESSIONAL CAMPAIGN  
IN THE THIRD DISTRICT OF NEBRASKA

(L. C. Card No. Mic 60-3023)

Alan Leland Clem, Ph.D.  
The American University, 1960

This is a comprehensive study of the 1958 congressional election in the Third District of Nebraska. It is believed that no published study has so close an acquaintance with and so frank a statement of the details of a congressional election. The scholarly literature on elections, political dynamics, and allied fields was studied to seek guidelines in approaching the study and to isolate hypotheses for testing in an actual election.

The body of the dissertation has three major sections. Chapters II and III discuss basic geographical and socio-economic factors, interest groups, and political history. Chapters IV, V, and VI discuss pre-primary campaign activities, finances, campaign and party organization, issues, and the methods and media used to transmit the campaign messages to the public. Chapters VII and VIII are concerned with analysis of the election returns. This involves analysis of party strength and voter turnout on the district, county, and precinct level as compared with figures from earlier elections as described in Chapter III.

Background information for Chapters II and III was largely gathered from U. S. Department of Agriculture and Census Bureau publications, Nebraska voting records, the incumbent representative's office files, conversations and correspondence between the student and Nebraskans from many walks of life, and observations of the student. Material for Chapters IV, V, and VI came almost entirely from newspaper files, office files, interviews, correspondence, and observations of the student. The bases of the analyses in Chapters VII and VIII are the precinct and county voting records, supplied by the Secretary of State of Nebraska and the 24 county clerks of the Third Congressional District.

Principal specific findings of the study are: (1) there was no positive correlation between Republican strength and livestock (as opposed to cash grain) predominance among farms on a county unit basis; (2) the more cohesive, vocal interest groups in the district in 1958 tended to support the Democratic candidate; (3) farmers and laborers, perhaps because their role in the economy makes them more amenable to government intervention, showed a stronger tendency to vote Democratic than the business-oriented inhabitants of towns of the middling size (in this area, towns between 1,000 and 5,000); (4) there was no strong or consistent correlation between voting level and Republican strength in the counties or the district as a whole; (5) Harrison's strongest areas in both elections were in the towns of from 1,000 to 5,000 and his weakest areas were the rural precincts; (6) rural precincts were most susceptible to violent shifts of voting behavior; (7) the congressional vote from county to county varied greatly from the county rankings of the gubernatorial and senatorial candidates, which were quite similar; (8) national issues were subject to local interpretation and variation in a congressional campaign; (9) the candidates largely decided the issues of the campaign, and their campaign statements and speeches were largely in answer to what they considered to be the most telling points made

by their opponent; (10) the whole campaign approach of the two candidates was different, with the incumbent appealing to the extreme "conservative" vote, the challenger to the middle-of-the-road voter; (11) although the two candidates spent about the same amount of money, they spent it in very different ways; (12) both candidates tended to work hardest in those areas where they had run poorest in 1956; (13) while Harrison made slight gains in many of Brock's 1956 strongholds, Brock made much more impressive gains in Harrison's 1956 strongholds.

The study concludes with a summary of the findings and suggestions for methodology of further studies of congressional elections.

Microfilm \$3.45; Xerox \$11.95. 265 pages.

POPULAR MOVEMENTS IN JAPAN  
DURING THE TAISHŌ ERA  
(1912-1926)

(L. C. Card No. Mic 60-3598)

Jung-shun Lin, Ph.D.  
University of Pennsylvania, 1960

Supervisor: Dr. Norman D. Palmer

The Meiji Restoration of 1868 launched the modernization of Japan. Under the centralized Meiji Government, Japan experienced exceptional national growth and progress. She deliberately applied the technological developments of the western world to her own requirements. As the Emperor Taishō ascended the throne, the Japanese found that their efforts in the Meiji era had pushed their nation into the rank of a major world power. Capitalism was growing fast. During the relatively short reign of Taishō, Japan became the third maritime power of the world, both in naval strength and commercial tonnage; her warships swept the Pacific and Indian Oceans and even the Mediterranean Sea; her arms penetrated three thousand miles into Siberia and controlled China; she lent money to Russia, France, and Britain; her representatives at Versailles enforced her will on reluctant Europe; her officials took part in determining Europe's new boundaries; her manufactures were in the greatest demand all over the world; and her growing power so alarmed the United States that the President called a conference at Washington to try to limit it, while the United States Congress passed a bill to prevent the flow of Japanese immigration.

The growth of the nation, however, brought about agonies also. While capitalism was ripening, poverty of farmers and laborers was left unsolved. The impoverished masses clashed with the governmental authority in unprecedented rice riots. The impact of Western ideologies, both in the forms of democracy and socialism, was felt in the increasing demands of the people. If the name of Meiji (Enlightened Rule) suggested what the preceding era had endeavored, i.e., modernizing the nation after the European pattern, "Taishō" (Great Righteousness) certainly implied an admonition, reminding the Japanese of the most urgent need of the time.

Political as well as economic legacies which Japan inherited from the Meiji era are explained in Part I. These were important because they were the factors which

set the course for both the democratic and socialist movements in the Taishō period. In order to win power and establish parliamentarism, bourgeois parties had to eliminate the undemocratic elements in the governmental structure, which had been handed down from the preceding era. And the economic situation of the nation was the force which drove the proletariat toward labor and socialist movements.

Evolution of parliamentarism is studied in Part II. The road to democracy was long and hard. But in their fight for a responsible parliamentary cabinet system and for universal suffrage, the bourgeois parties found the people on their side. Angered by the continued undemocratic practice of appointing cabinets independent of the Diet, people from all strata of society — businessmen, laborers, students and women alike — staged nation-wide demonstrations. Parliamentarism was established, but the war for democracy just began.

Part III analyzes the impact of Western ideologies on the Japanese and examines their fruit, the mass organizations. The political thoughts which dominated the minds of the Japanese people in the Taishō era were the "Emperor-is-an-organ" theory of Dr. Tatsukichi Minobe and Minponshugi, democracy as it was interpreted by Dr. Sakuzō Yoshino. The tide of Socialism was also felt in the mass organization movements. At the same time, the rising rightist organizations were given a bible when Ikki Kita wrote his *A Bill for the Reconstruction of Japan*. And so, ultra-nationalist organizations, which never had any ideologies of their own, were gradually converted to national socialism.

The last Part is devoted to the proletarian movements, explaining both the labor union movement and the proletarian party movement. The last years of the Taishō era were characterized by labor unionism and the proletariat's efforts to organize proletarian parties.

It is hoped that this study may throw some light on the political significance of the rather neglected Taishō era. Analyses of the democratic and socialist movements of those years, their successes as well as failures, may help the study of present day Japan and furnish a clue to her future. Microfilm \$16.70; Xerox \$23.85. 527 pages.

#### THE LEGISLATIVE ASSEMBLIES OF THE CANADIAN PROVINCES

(L. C. Card No. Mic 60-3528)

Hugh Gordon MacNiven, Ph.D.  
University of Minnesota, 1960

The legislative assemblies of the ten Canadian provinces have been thought of as little models of British parliamentary practice and, therefore, not needing individual examination. This dissertation investigates the grafting of a parliamentary system to a federal arrangement to see if it has developed a local legislative adaptation well suited to today's provincial needs.

The study reviews the legislative history of the British North American colonies from establishment of British rule in 1759 to Confederation of the colonies into the Dominion of Canada in 1867. Failure of representative government culminating in the rebellion of 1837 and growth

of responsible legislative forms following Lord Durham's report in 1840 are both developed. By 1867, mature local legislatures were found in the province of Canada and in the Maritimes. These legislatures exercised wide powers and were aggressive in extending them. They exhibited few novel characteristics with the exception of an elective upper House in the province of Canada.

The fathers of Confederation, in establishing the new Dominion, intended the provincial assemblies to exercise little more than municipal functions. The British North America Act of 1867 enumerated Dominion and provincial powers in as specific terms as seemed possible. Over the intervening years, however, judicial decision, especially as regards property and civil rights in the province, and new demands for provincial services have combined to increase greatly the scope of provincial legislative power.

Exercising their right to amend the provincial constitutions, the assemblies have from time to time altered size of their membership, times and durations of their sessions, and abolished upper Houses in five instances. Problems of representation and reapportionment are found to be essentially similar between the provinces and the American states.

The role of the Speaker and other legislative officers; rules and standing orders; privileges and immunities; and the committee system are detailed and contrasted with British, Dominion, and American usage. Development of legislative organization is shown to be similar from province, but minor differences are noted. The committee system, while avoiding some of the problems associated with American committee procedure, has, nevertheless, failed to keep pace with new developments found in Great Britain, and it is found to be antiquated and inefficient in the provinces.

Nomination, election, qualification of members are traced; characteristics of provincial members are analyzed. Using biographical sketches from all the provinces, data is tabulated on age, national background, legislative experience, education, occupations, religion of members.

Procedures having to do with opening, prorogation, and dissolution; passage of public and private bills; adoption of the budget; debates and divisions; use of question time are examined to show local adaptations and contrasts. Comparative costs of the ten legislatures are given.

Absence of constitutional guarantees of civil and property rights makes possible infringement by the legislative assemblies. Several examples of abuse are cited; but after review, it is felt that a "bill of rights" inserted in the B. N. A. Act would in reality add little to the protection now afforded by the courts. It is concluded that provincial legislative efficiency is hampered by the amount of local and special legislation introduced, which could be handled better by general laws and administrative procedures. The charge that the cabinet runs roughshod over the private member in a parliamentary system appears less serious in the small provincial Houses than in larger legislatures. The private member, especially in opposition, is handicapped by a lack of research facilities such as are at the disposal of cabinet members.

A general evaluation shows the provincial assemblies are well organized and efficient in most respects to carry out the public business, but conservative in making changes in procedures which would further effectuate their operation.

Microfilm \$4.00; Xerox \$14.20. 311 pages.



INDONESIANISASI:  
A HISTORICAL SURVEY OF THE ROLE  
OF POLITICS IN THE INSTITUTIONS  
OF A CHANGING ECONOMY FROM  
THE SECOND WORLD WAR TO THE EVE OF  
THE GENERAL ELECTIONS (1940-1955).

(L. C. Card No. Mic 60-2494)

John Orval Sutter, Ph.D.  
Cornell University, 1959

There has been a growing body of literature in English on the subject of Indonesia, the second largest state to emerge independent following World War II and potentially one of the world's richest. Political scientists have traced its political history before and after the proclamation of independence, and economists have scrutinized the "plural economy" of its colonial period and the problems of contemporary economic development. The present study, however, is the first comprehensive one with a combined political-economic approach. It is concerned primarily with Indonesianisasi (Indonesianization) in the economy, a process which--notwithstanding a previous lack of published material--has generated sustained interest among many residents of Indonesia as well as groups in those countries which have provided large-scale investments or economic aid.

Although Indonesia (Netherlands East Indies) was a leading exporter of a variety of primary commodities before World War II, it was also the world's most populous country without an important indigenous business group. Indonesians occupied the bottom level of their country's plural economy, below both the hegemonous position of the metropolitan Dutch and the intermediate tier of the immigrant Chinese. A decade after their republic had been proclaimed (by which time the first general elections had been held), Indonesians were not only operating state enterprises, but were also developing a dynamic group of businessmen seeking to end the plural nature of the economy.

A trinity of elements comprises the subject matter of this dissertation, of which the first is Indonesianization--the whole process of enhanced participation by the Indonesian in his economy, whether in the state or private sphere. Indonesia's great diversity was evidenced not only in its manifold political parties, but also in the concepts concerning the ideal "national economy" to be striven for. Accordingly, the varied and changing ideologies and political-economic programs, which affected the process of Indonesianization, form a second element. The third element is the status of the other participant in the developed, business sphere of Indonesia--foreign enterprise.

The dissertation, in four parts, examines successive periods of Indonesia's recent history. Part One, "The Indonesian Economy at the Close of the Dutch Period," surveys the relative position of alien and indigenous business in each important economic sector around 1940 and 1941, and sketches the economic thinking of Indonesian political groups of the pre-war period. Part Two, "Reorganization of the Indonesian Economy under the Japanese" (1942-1945), describes the Japanese replacement of the Dutch in the leading economic positions and cites evidences of Indonesianization. In addition, note is taken of the experiences of Indonesian leaders in both the political and economic arenas during this period of increasing economic

hardship and the gestation of Indonesian independence (which aimed at autonomy in the economy).

Part Three, "The Indonesian Economy Split by Revolution," traces the efforts at economic rehabilitation by the governments of the two competing political entities in the archipelago: the Indonesian Republic and the Netherlands Indies. The economic goals of the diverse political organizations which mushroomed during this period (1945--1949), their efforts towards implementation, the growth of new Indonesian enterprises, and preparations for the return of foreign enterprise are also examined.

Part Four, "Sovereign Indonesia Strives for a National Economy," furnishes specific and detailed examples of Indonesianization in each principal sector of the economy during the period 1950 to 1955. It also contains a review of general attitudes concerning the dissertation's three-fold subject as expressed by successive cabinets and debated in Parliament.

A glossary of Indonesian, Dutch, and Japanese names is provided.

Microfilm \$16.80; Xerox \$60.00. 1335 pages.

POLITICAL SCIENCE, INTERNATIONAL  
LAW AND RELATIONS

U.S.-ISRAELI RELATIONS  
DURING THE DECADE 1948-1958

(L. C. Card No. Mic 60-4599)

Fred Dixon, Ph.D.  
University of Virginia, 1960

The decade under consideration has ended so recently that available primary material revealing diplomatic exchanges is limited. The current study, which is not a history of U.S.-Israeli relations, attempts first to uncover the reasons underlying the part played by the United States in regard to the General Assembly partition recommendation of November 1947, and the recognition of the *de facto* government of Israel some six months later. From a survey of public opinion, political pressures and maneuvering in connection with initial United States policy toward emerging Israel the course and influence of American public opinion on government policy throughout the decade is then traced by consideration of public opinion polls, contemporary news media, public documents, and collateral sources to reveal the operative factors determining U.S. policy.

Even cursory examination of the American political scene quickly reveals the existence of a strong, unified, and well-financed pressure group which for several decades promoted the idea of a Jewish national home in Palestine, then the concept of an independent Jewish state, and now operates to serve the interests and programs of Israel. This group comprising various Zionist organizations and Israeli sympathizers has by contributions of hundreds of millions of dollars and by political pressures on public figures and politicians functioned directly and indirectly to finance and support Israel in a variety of ways. A large part of the private contributions have been subsidized by

the Government through the classification of the donations as tax-free charity giving. In its turn, the U.S. Government has contributed financial support to Israel about equal to that provided by Zionists.

United States policy has been weighted in favor of Israel as compared to the Arab states of the Middle East. This may be considered the crux of the situation. There has been an effort made under the current Administration to establish a balanced approach to all the countries of the Middle East, but it is the loss of flexibility which has evolved from the peculiar nature of U.S.-Israeli relations that point up the need for a careful reappraisal of the proper posture of the U.S. in regard to the Middle East as a whole. From the standpoint of national policy Israel constitutes but a very small fraction of the area. This foreign state deserves help and support on a par with other states in the area. Utterances and activities of many politicians reveal their ignorance or disregard of U.S. interests in their conditioned eagerness to appear as Israeli champions.

The decline of British influence in the Middle East and the tempo of the Cold War force upon the United States the role of attempting to retain access for the West to the strategically critical area and the three-fourths of the world's proved oil resources it contains. Soviet penetration of the area has been relatively successful. The domination of the Middle East by the Soviets would result in an incalculable loss to the West.

It is in the national interest of the United States to prevent this loss. United States foreign policy suffers an unjustifiable handicap when it is hampered by an unrealistic involvement which requires that Israel be favored as against the rest of the area. The past decade indicates that a strong pressure group, if unopposed by any organized more politically sophisticated public opinion, may be expected to favor a preferred position for Israel advocated as consistent with the national interests of the United States. Considering the Cold War and Middle East tensions, the national interest requires a balanced policy.

Microfilm \$3.95; Xerox \$13.95. 308 pages.

#### THE ORIGIN AND DEVELOPMENT OF THE 1891 INTERNATIONAL COPYRIGHT LAW OF THE UNITED STATES

(L. C. Card No. Mic 60-3100)

Joel Larus, Ph.D.  
Columbia University, 1960

In the absence of a treaty there is no principle of public law requiring one country to respect the copyright protection granted by another state. Literary piracy, that is, the unauthorized reproduction of a protected work belonging to another state's nationals without acknowledgment of their property rights, has been known to exist in Europe at least since the invention of the moveable type press.

The United States also has had a long career of engaging in similar practices. During most of the nineteenth century this country was generally considered to be the leading literary piratical state in the world. Only on March 3, 1891 was the first international copyright law enacted by

Congress, thus removing the century old disability against the intellectual works of non-resident aliens.

This dissertation undertakes to present a case study of how a wide range of extra-legal factors--historical, economic, technological, and political--at first helped determine the original international copyright position of the newly formed American government and later foreshadowed the restrictive provisions incorporated into the 1891 law. It has been our purpose to show how and why these domestic considerations and strongly entrenched pressure groups impeded what otherwise might well have been an orderly development in the United States of this area of international law. An historical development of how these forces aligned themselves, as well as their tactics, forms the main body of this work.

On one side was an influential group of publishers, later joined by politically powerful trade unionists, who were convinced that their economic well-being required them to oppose liberalization of our existing copyright legislation, unless strong protectionist features were generously incorporated into any treaty or domestic law. Supporting them were many thousands of men and women throughout the country who wished to continue buying English literature, the principal source of these pirated works, and who could see no convincing reason why royalty payments should be added to the purchase price, especially when such unauthorized reprints violated no domestic law or international law norm.

In opposition were most of this country's men of letters. They hoped to benefit materially if a reciprocal arrangement could be worked out with Great Britain because only then would their intellectual works become commercially attractive to American publishers. They also sought to stop English publishers from pirating their works. This group was supported by others who were convinced that the intellectual development of the United States depended on such remedial legislation. Allied to these forces were those who wished to encourage the progressive development of international law and world cooperation and who believed that this area was a fertile one for progress.

This study indicates that there is a close relationship between the growth of American international law, or at least those areas having commercial significance, and domestic pressure groups. The latter seem able to stifle for exceptionally long periods of time the liberalization of a particular policy dealing with an international law topic when they believe that revision is not in their economic interest. As a consequence, there is some reason to believe that those seeking to determine why one state accepts a proposed international law standard, while another rejects it outright, can not afford to restrict their studies to diplomatic communications and public pronouncements, as has been done in the past. The domestic forces that become involved in such matters must be isolated and their reasons determined with a good deal of exactness. It is only then that a policy of compromise and accommodation can proceed on a rational basis. Evidence is also offered in this dissertation that private pressure groups seeking to bring about a revision in an American international law position should concentrate their attention on certain specific arguments that have appeal to the public generally. Other lines of reasoning should be delegated to secondary status or ignored completely.

These conclusions finally have been applied to the



current dispute now facing the United States vis-a-vis the Soviet Union. Recently individuals and private groups in this country have become concerned with the Soviet's practice of translating and publishing without permission whatever American copyrighted work that they wish, a situation that has many analogous features to the one examined in the main part of the essay. Based on the conclusions presented, it is the author's opinion that such American nationals or pressure groups would have greater chances for bringing about a change in the policy of the Soviet Union if a punitive policy was followed, rather than one that is open and generous.

Microfilm \$3.20; Xerox \$11.25. 248 pages.

**THE SYRIAN NATIONAL PARTY:  
A CASE STUDY OF THE FIRST INROADS  
OF NATIONAL SOCIALISM IN  
THE ARAB WORLD.**

(L. C. Card No. Mic 60-2943)

Nadim K. Makdisi, Ph.D.  
The American University, 1960

The purpose of this Dissertation on the historical development and political philosophy of the Syrian National Party is to probe into the first manifestations of the dogma of national socialism in the Arab World. The Dissertation begins with an analysis of the political conditions prevailing in Syria and Lebanon during the early years of the nineteen thirties which made possible the founding of the Syrian National Party by Antun Sa'adeh. It, then, goes on to describe the rapid growth of the Party, its clash with existing political groups, and its suppression by the French Mandatory power.

In his annunciation of the Fundamental and Reform principles of the Syrian National Party, Sa'adeh revealed the national socialistic character of his new movement. "The Syrian National movement," he declared, "seeks its inspiration in the talents and genius of the Syrian nation and its national & political history." He, further, states that "the Syrian Nation is one socialistic community."

Sa'adeh was, undoubtedly, greatly influenced in the development of his political thinking by such super nationalist philosophers as Nietzsche and Schopenhauer, and by such contemporary dictators as Hitler and Mussolini. He must have drawn a parallel between Hitler's objective to unite the "German race" in one nation and his aim to unite the "Syrian people" in a Greater Syria. His Party was, thus, centrally organized and, according to its Constitution, he was the supreme commander of its forces, and the source of all legislative and executive authority.

Following the collapse of the Axis powers and the ensuing unpopularity of their brand of dictatorship, Sa'adeh took refuge in the national socialist ideas of the Peronista movement in Argentina and attempted to adopt them as his platform following his return to Lebanon from exile.

Perhaps what stands out most about the Syrian National Party is the fact that it was the first political movement in the Arab World which was organized along modern political principles. Prior to the founding of the S.N.P., political movements in the area were, at most, centered around dogmas and ideas whose propagators lacked the planning

and organizational discipline introduced by Sa'adeh. Even communism was at that time, to those who confessed to it in the Arab World, more in the realm of ideas than as an organized political movement.

The significance of the Syrian National Party is manifest today in the fact that it was able to withstand all attempts at destroying it. Since its inception it has been the subject of the enmity of almost every government in Syria and Lebanon, and every other political organization in those two and other Arab League countries. Nonetheless, it survived mainly because of its strong discipline, and is able to elect members to the Lebanese parliament.

Microfilm \$2.80; Xerox \$9.70. 214 pages.

**POLITICAL SCIENCE, PUBLIC  
ADMINISTRATION**

**A COMPARATIVE STUDY  
OF THE UNITED STATES PATENT OFFICE  
AND THE GERMAN PATENT OFFICE**

(L. C. Card No. Mic 60-2951)

Simon Broder, Ph.D.  
The American University, 1960

A patent is a grant by a sovereign to an inventor whereby the inventor is permitted to exclude others from making, using, or vending a particular invention for a limited time, in return for a full disclosure by the inventor of his contribution. After the term is over, the invention becomes public.

The United States, Germany, Great Britain, and other countries have established offices to process applications for patent. Mainly the concern is to examine the applications for the purpose of determining whether the contribution is worthy of the patent grant. In other countries, France for example, a patent is granted on mere application, without examination, and the courts are left to determine the validity of the patent if and when the patentee seeks to enforce his rights. In every land a necessary requirement for a valid patent is novelty, that is, the invention must be new, for obviously only the first inventor should be given the patent award.

A second and far more troublesome criterion is the measure of advance of the contribution, if new, over the known prior art. This criterion is called the measure of invention. If the quantum of contribution is less than the prescribed minimum, a patent is denied.

A determination of novelty and invention can be made only by examiners who are skilled in the art. Of course, there must be a comprehensive collection of patents, books, periodicals, and other records, in more than one language, so that a search will give valid results.

The United States and Germany are the prime exponents of the examination system for patent applications. This study describes in some detail the organization of the United States Patent Office, and in lesser detail the organization of the German Patentamt or Patent Office, and points out the basic theories on which the respective practices are based. The United States system, it appears, requires

the applicant to portray a preferred embodiment of his invention, for the disclosure must be complete without requiring further experimentation, and to use great care in formulating the claims, on the theory that the words thereof delimit the patent monopoly.

On the other hand, the German applicant need only describe his idea in language that will give an expert sufficient background to permit him to work out an embodiment. The claim need only describe the idea of the invention, for the German tribunals will give the inventor a monopoly limited only by the invention and the scope of the prior art, and not by the wording of the claim.

In procedure, the German Patentamt differs sharply from the United States Patent Office in employing the opposition proceeding, whereby an application that has been approved by the examiner is opened to public inspection and opposition before it can be patented. The additional perusal by the public supplements the German examiner's investigation, and hence an issued German patent is presumed to have victoriously emerged from a closer scrutiny than has a United States patent. For this reason the German patent may be said to have a stronger presumption of validity. The German opposition is similar to the United States trade-mark opposition and is analogous to the patent interference.

The writer believes that the German opposition might well be adopted by the United States Patent Office, for reasons hereafter pointed out. Other suggestions are also discussed.

The United States Patent system has much to commend it. Some procedures, however, should be revised with a view to expediting or increasing the benefits sought by inventors in particular and by the public in general.

Microfilm \$3.45; Xerox \$12.15. 268 pages.

**VOL. I: THE POLITICAL AND ADMINISTRATIVE  
LEADERSHIP OF FIORELLO H. LAGUARDIA  
AS MAYOR OF THE CITY OF NEW YORK,  
1934-1941.**

**VOL. II: AN ADMINISTRATIVE STUDY OF  
SOME ASPECTS OF THE 1934-1941  
MAYORALTY OF FIORELLO H. LAGUARDIA.**

(L. C. Card No. Mic 60-3782)

William Paul Brown, Ph.D.  
New York University, 1960

Adviser: Professor Martin B. Dworkis

This is a study and evaluation of the handling of two broad administrative areas and one large-scale, long-term administrative problem by a New York City Mayor in the years 1934-1941. The administrative areas analyzed include the policies and relationships with (1) the general personnel force of the municipality and (2) the agency chief executives. The administrative problem focused upon, virtually as a case study, is that involved in transit unification.

**Background** - New York City in 1934 was struggling in the depths of a depression. LaGuardia, a 51-year old, very independent Republican of Jewish-Italian parentage and Western-American upbringing and viewpoint, won the

Mayoralty, a position involving one of the Nation's most difficult public administrative tasks. He had had a colorful and accomplishment-packed background in the federal legislature, the consular service and the Army but almost no administrative experience. In his favor he had honesty, brilliance, energy, political wisdom, a totally defeated political opposition and the friendship of President Franklin D. Roosevelt with its implications for great New Deal assistance.

**Commissioner Relationships** - The evidence indicates that LaGuardia was influenced in his early commissioner selections by his political and personal associations with the Fusion group but the least of his political appointees was capable, the majority of unquestioned ability. A number of outstanding non-political experts were also brought into the first cabinet. Commissioners were forbidden any political activity with the result that the strongly politically minded left City office within a few years. Of the department head replacements during the eight years under study, 22 were by promotion with a constantly increasing emphasis on the elevation of longtime civil servants to the commissionerships. The remaining seven replacement commissioners were highly qualified experts.

LaGuardia demanded of his commissioners a positive, client-centered, non-bureaucratic, moralistic, 24-hour-a-day service with strict economy as a major emphasis. He drove and led them by a combination of charismatic leadership, dynamic and dedicated example, and a ceaseless probing into the minuties as well as the major issues of departmental administration. He was often unfair or aggressive but this was usually accepted by his commissioners - almost all program-centered men - as a standard reaction not seriously weighing against the support he gave in carrying out their tasks.

**Personnel Relationships** - LaGuardia's most important influence on the general personnel force was in interaction with his Municipal Civil Service Commission. His relationships with each of the two Commission presidents seem to have been unsatisfactory and he was constantly and contentiously involved in personal details. Still positive results were forthcoming. Personnel work appears to have been established as an important, scientific specialization; the career concept was fostered; the merit system was advanced in many previously exempt or non-classified categories; examination, classification, training and rating practice were substantially improved.

In other than Commission personnel dealings, LaGuardia provoked strong civil service opposition by his economy emphasis with its resultant pay cuts and job reductions and his insistence on good, constant, honest work. In these years employee organizations - formerly of the benevolent association type - became more vigorous and civil service unions became important. Most effective of the new organizations was the Transport Workers Union and in contacts with this group important labor precedents were established. Unfortunately labor issues were handled on a day-to-day basis and the opportunity to develop a consistent, well grounded employee organization policy seems to have been largely lost.

**Transit Unification** - The rapid transit problem had complex roots going back 75 years. Unification had been seriously considered for 15 years but had never even been close to attainment. In the years 1934-1937 the Fusion efforts were directed by two of LaGuardia's most trusted associates, Professor A. A. Berle Jr. and



Judge Samuel Seabury. Though unsuccessful they were able to dispose of the long-held idea that a public corporation could carry out unification with a guaranteed five-cent fare, and guaranteed City control coupled with City immunity from financial liability. The Mayor remained in the background, although in constant contact with his transit advisors, except for a series of bitter attacks on the State Transit Commission, an agency with unification as a statutory responsibility but whose members appear to have been determined to delay unification which would have endangered their jobs and given glory to LaGuardia, a political enemy.

By 1938, strong opposition to unification had disappeared. With the addition of a pro-LaGuardia commissioner to the Transit Commission, City and State began to cooperate. Both accepted the necessity for City-backed financing of any transit purchase and a Constitutional amendment empowered the City to issue the necessary bonds. Unification was accomplished.

**Evaluation** - From the broad and the specific analyses there emerges a picture of LaGuardia as a tough, brilliant, absolutely dedicated, personally honest (though the end justified almost any means) politician-administrator. He was a master in dealing with individual human beings and individual issues rather than an administrative scientist working with a consistent and consciously evolved set of administrative principles. Still he was able to stretch himself enough so that much was accomplished in these eight years. Concrete accomplishments, parks, bridges, buildings, etc., were made in quantity but the major achievements were intangible. He brought dignity and help to the most underprivileged, including the newly emergent labor force of the '30s'. Most important, he gave a disillusioned, depression- and corruption-racked City a belief that honest, efficient government could be achieved.

Microfilm \$4.70; Xerox \$16.45. 365 pages.

HIGHER CIVIL SERVANTS  
IN THE PHILIPPINES: A STUDY OF THE  
BACKGROUNDS, CAREER PATTERNS,  
AND ATTITUDES OF  
FILIPINO HIGHER OFFICIALS.

(L. C. Card No. Mic 60-3514)

Gregorio Adriano Francisco, Jr., Ph.D.  
University of Minnesota, 1960

This study deals with an administrative elite, the higher civil servants in the Philippines, and their backgrounds, career patterns and attitudes. It seeks insights concerning the workings of the bureaucracy by describing higher bureaucrats, and gauging their attitudes towards the prestige value of public employment, merit and patronage, human relations, etc. The methodology involves a survey which utilized both questionnaires and interviews with 126 respondents drawn on a stratified, random sample basis from top administrative officials. There is also a discussion of ecological factors affecting Philippine administration and a brief narrative of the historical development of the civil service.

Certain features of the administrative elite emerging from the survey distinguish Filipino bureaucrats from

their foreign counterparts and offer bases for explaining bureaucratic behavior. Filipino officials are relatively older than their American and Egyptian counterparts. All but 5% have had a university education, mainly in law. This confirms the popular belief that law is considered the best preparation for the public service and partially explains the Filipino legal emphasis on administration. Over a third of the group have fathers of working class origins indicating social mobility. The rest are evenly apportioned among the middle and the upper classes, making them a truly heterogeneous group. Their current sources of income, home-ownership and car-ownership identify them as middle and upper class in their present socio-economic status. The factors of age, education and socio-economic status, when correlated with these officials' responses to attitudinal questions, provide rational explanations for their administrative thinking and behavior.

Their career development reveals the absence of a genuine career service system. Instead of learning about civil service opportunities formally, the majority learned of their first job through friends, relatives and personal inquiries. Many entered the service without civil service examinations. Their progression also shows lack of planning. Instead of climbing definite career ladders, their careers zigzagged from manual or clerical to technical, and finally to administrative posts. These findings, plus the weakness of the merit system, militate against the early possibility of creating a Philippine administrative class.

The attitudes of higher officials towards the government partially indicate the prestige value of public employment in this country. Their responses depict government service as viewed attractively by the public because of secure tenure and liberal fringe benefits, but also as not held in much respect. The latter view is attributed to the rampant graft and corruption in government and failure of its leaders to live up to their commitments.

Although the responses of higher civil servants show preference for merit methods in the selection process, the pervading influence of patronage and the "charity" concept was apparent. High unemployment generating pressures on politicians to provide livelihood to their constituents and the nature of family relationships in Philippine society block the effective application of merit principles. Human relations is accepted more as a desirable ideal than a practical approach to management. When asked to choose techniques for dealing with their subordinates, officials gave replies favorable to human relations techniques in the abstract but not in practice. The strength of the authoritarian tradition may explain this.

From the findings, expected future developments in the bureaucracy include a greater number of public administration-trained officials in the public service. Also, broad educational opportunities will mean greater social mobility among civil servants. The increasingly industrialized private sector will offer stiff competition to government with a possible further decline of the latter's prestige value. Patronage will continue as a dominant force in selection until unemployment is reduced and a reorientation of values in the society occurs. However, in time education might increase citizen responsibility and elevate government prestige.

Microfilm \$6.00; Xerox \$21.40. 471 pages.

**CENTRALIZATION AND DECENTRALIZATION:  
A STRUCTURAL-FUNCTIONAL APPROACH  
TO COMPARATIVE STUDY OF  
PUBLIC ADMINISTRATION.**

(L. C. Card No. Mic 60-2833)

Reza Rezazadeh, Ph.D.  
Indiana University, 1960

The aim of the study is to consider structural-functional aspects of centralization and decentralization in theory as well as in actual operation. To avoid confusion in terminology, first the intended meaning of some terms is clarified. Then different theoretical approaches to the subject are considered. Among these are the concept of centralization and decentralization under the Pure Theory of Law, socio-economic theory and group process theory. Under the former, a systematic analysis of the subject is made by Dr. Hans Kelsen. Dividing the subject into static and dynamic types he offers a specific classification and gives precise definition for different forms of centralization and decentralization.

The socio-economic concept reveals a general process that centralization and decentralization follow within each social setting when this setting passes a stage of transition from an agrarian to an industrial order. According to this concept if the stage of transition of a country is known, one can determine the expected structure of centralization and decentralization in its governmental organization.

The group process theory is resorted to for investigating the actual operation of centralization and decentralization within different social settings. The concept employed here is the result of analysis made of different approaches to group structure and activities. The conclusion reached is a new method of approach seemingly more appropriate for organizational analysis.

The analysis of administration under this concept suggests two conclusions: first, how centralization and decentralization can be used in the study of an organization; second, how the process of centralization and decentralization work within different social settings.

The first conclusion is reached because of the fact that almost any aspect of the administration that one may be concerned with is somehow related to, and affected by, centralization and decentralization. Thus one may receive a better picture of the organization and his task of analysis may become easier if he starts with an investigation of the centralization and decentralization processes.

To achieve this end the structural and functional as well as the actual operational aspects of the process are examined. The use of a socio-economic concept determines the stage of centralization and decentralization in its general course within a specific organization. This suggests the general picture of the process that could be expected in the actual study of such organization.

Then through Kelsen's theory the structural aspect of the organization is more easily determined and distinguished from its functional aspect.

Finally by the observation of all group activities and relationships concerned with the organization the actual operation of centralization and decentralization is examined and the causes of differentiation between the theoretical structure and actual functioning are revealed.

The second conclusion suggests that in an autocratic type of organization centralization and decentralization

have a preset scheme and are enforced and often irrational, whereas in a democratic order they have no pre-arranged structure but are automatic and continuously changing. Variations in the latter occur as an effect and reaction of the social changes rather than as a result of an individual or particular group will.

Microfilm \$4.55; Xerox \$16.00. 355 pages.

**ANALYSIS OF PERSONNEL MANAGEMENT  
IN THE MINISTRY OF AGRICULTURE  
OF VENEZUELA**

(L. C. Card No. Mic 60-2945)

George Sugarman, Ph.D.  
The American University, 1960

The major purpose of this dissertation is to analyze the personnel management functions of the Ministry of Agriculture of Venezuela.

In order to do so, each of the processes from recruitment to separation, as conducted in the Ministry was examined and described. Party politics and administrative law, so often and traditionally equated in Latin America with public administration, were beyond the scope of this analysis.

A concerted effort was made to thoroughly observe every aspect of the Ministry's personnel systems and procedures in theory and operation, report on their effectiveness in accomplishing their goals, and based on these, prepare recommendations.

Throughout, and to the degree possible, observations were made from the perspective of the Ministry and Venezuela. This required constant reference to the individual and to the cultural setting.

The writer lived and worked in Venezuela from June 1954 to May 1959. He gave private, government and university courses in management to, and did consulting with leaders of government, industry, and the armed forces, in the Spanish language. This period embraced three and a half years of dictatorship, eleven months of a junta, and four months of a constitutionally elected president. There was a major revolution, numerous golpes de estado (coups d'état), several changes of ministers, and the initiation of many experiments in personnel management, the most important being the United Nations inspired Public Administration Commission.

The Ministry of Agriculture was the earliest agency to attempt a formalized personnel system; two hundred of its officials were management seminar graduates, and their files, opinions, meetings, confidences and friendship were extended to the writer. Few other sources were available since there is a great sparsity of critical, analytical, historical and descriptive materials on public personnel administration in Venezuela and in Latin America.

Though the Ministry of Agriculture was more advanced than most agencies in management theory, structure, and paperwork, it typified Venezuelan government-wide public personnel administration in practice.

The Ministry's and Venezuela's personnel practices were characterized by a great deal of enthusiasm, the willingness to be exposed to new ideas, excessive paperwork,



skills in short supply, patronage, nepotism and job insecurity. Due in large part to lack of opportunities for training, and because public employees had always been at the mercy of temporary and transient governments, the personnel management functions of the Ministry and the

public service have been substandard and inadequate to the needs of Venezuela.

The Venezuelan people deserve a far better system of public administration than they had.

Microfilm \$5.15; Xerox \$18.25. 404 pages.

## PSYCHOLOGY

### PSYCHOLOGY, GENERAL

#### COMMUNICATOR-CREDIBILITY AND COMMUNICATION-DISCREPANCY AS DETERMINANTS OF OPINION CHANGE

(L. C. Card No. Mic 60-3442)

Tong-He Choo, Ph.D.

Boston University Graduate School, 1960

Major Professor: Walter Weiss

Although previous researches have directed considerable attention toward the effect on opinion change of isolated variables such as communicator-credibility and communication-discrepancy, among others, little attempt has been made to incorporate these variables into a single experimental design in order to assess their separate as well as combined effects. The purpose of the present study is to vary experimentally the degree of communicator-credibility and communication-discrepancy, thereby investigating the main and interaction effects of these two variables on opinion change.

Reviewing the existing research evidences leads to the following hypotheses:

Greater extent of opinion change toward the communication is expected when: communicator is high-credible than low-credible; and communication-discrepancy is large than small. When the communicator is high-credible, greater extent of opinion change is expected for large-discrepancy than small-discrepancy group. No hypothesis is advanced on the effect of communication when the communicator-credibility is low.

In order to test the above hypotheses, a before-after design was used. Among 216 college students, 149 subjects, who served as the experimental group, were exposed to the communication which advocated the idea that there is no causal relationship between cigarette smoking and lung cancer. One half of the experimental subjects read the communication in which the source is attributed to a high-credible communicator and the other half read it from a low-credible communicator. Also, for one half of each group, a few additional anchor statements, that some people hold to the opinion-extremes on the issue, were inserted at the beginning of the communication in the expectation that these anchor statements would affect the subjects to judge the communication as less extreme than they would without these anchor statements. The former is, therefore, called the small-discrepancy, and the latter the large-discrepancy groups.

Opinion positions on the issue discussed in the com-

munication were measured before and after the communication. In addition to these, a series of judgmental items was included in order to obtain measures on the experimental variables, and other relevant information.

The control group (N=67) gave their opinions before reading the communication, and then made the same judgments of the communication as did the experimental subjects.

The checks on the experimental manipulations of the above two variables indicate that only the high vs. low communicator-credibility was successfully differentiated. Due to the failure of the manipulation of the discrepancy variable by anchor statements, the communication-discrepancy of the present study was derived from the subject's judgments on the communicator's position.

The subjects were divided into two groups using the median of the communicator's position judged by the subjects as the cutting point. The above-median groups is called the small-discrepancy group, and the below-median the large-discrepancy group, since the below-median group as a whole is more discrepant than the above-median group with reference to their over-all initial opinion position. The control subjects were also separated on this communication-discrepancy.

The opinion change is assessed by the change score from before to after communication. The experimental group showed significantly greater extent of opinion change toward the communication than the control group showed. The results also confirmed the hypotheses advanced. Thus:

(1) The group who received the communication which was attributed to the high-credible source significantly changed more toward the communication than did the group which read the communication from the low-credible source.

(2) The subjects who judged the communicator's position as more discrepant from their own stand changed significantly more toward the communication than did those who judged it less discrepant.

(3) The interaction effect between these two main variables, communicator-credibility and communication-discrepancy, was not significant. That is, within high- and low-credible groups, both large-discrepancy groups changed more toward the communication than did the small-discrepancy groups.

Microfilm \$2.50; Xerox \$5.20. 105 pages.

# SELECTION OF EXECUTIVES FOR A TRAINING PROGRAM

(L. C. Card No. Mic 60-4172)

Leopold Wilhelm Gruenfeld, Ph.D.  
Purdue University, 1960

Major Professor: Dr. Joseph Tiffin

Measures of performance on five intelligence and achievement tests were obtained from forty-eight participants in a management development program. In addition a forced choice Self-Description Inventory was given. Faculty and peer ratings were used as criteria of success of individuals in the program.

In the first phase of the investigation, the subjects were assigned at random to a primary and a hold-out group. No combination of tests could exceed the predictive efficiency of the best single test with the criteria. However, results obtained were less reliable than those obtained when the entire group was used as one sample.

In the second phase of the investigation, the entire sample was used as one group. Obtained multiple correlations were shrunk and a prediction equation was derived.

The Purdue Industrial Supervisors' Word Meaning Test correlated .60 with the faculty criterion and did not differ significantly from the correlation of The Adaptability Test with the faculty criterion which was .55. The combination Purdue Industrial Supervisors' Word Meaning Test and the Industrial Mathematics Test correlated .64 with the faculty criterion. The Adaptability Test, a fifteen minute intelligence test, was recommended for selection of future candidates for the management development program.

Factors measured by the Self-Description Inventory did not correlate significantly or consistently with the faculty criterion with one exception, in which the relationship was low. Microfilm \$2.50; Xerox \$5.00. 99 pages.

## WORD KNOWLEDGE OF INDUSTRIAL SUPERVISORS

(L. C. Card No. Mic 60-3555)

Sally McMurdo Hotchkiss, Ph.D.  
University of Minnesota, 1959

Adviser: Donald G. Paterson

Starting from the assumption that supervisory personnel play a key role in the communication process within industry, the prime purposes of this investigation were to assess foremen's and higher-level supervisors' knowledge of words occurring in industrial communications and to determine the significance of any differences between the two levels and between each of them and non-supervisors. A multiple-choice vocabulary test was constructed from words appearing with sufficient frequency in a count made on a sample of 172,648 running words drawn from industrial house organs, bulletin board notices, and employee handouts; these words represented the various Thorndike-Lorge grade levels. An additional form was derived from

communications issued specifically for supervisors and from the Dictionary of Occupational Titles glossary.

One hundred items, in which from one to all of the alternatives were synonymous with the stimulus word, were administered to 76 Level 1, 117 Level 2, and eight unclassified male production supervisors (volunteers) from four varied plants. Fifty of these items were also administered by another investigator to 162 male job applicants. Scores of "higher" supervisors were consistently superior to those of "lower" foremen, and performance of both groups on the fifty supervisory items was superior to that on the fifty general industrial items. Comparisons between educational groupings within the two levels revealed a positive but not high relationship between test scores and highest school grade completed; the variables of total time employed in industry and time in current position exerted no appreciable influence upon these vocabulary scores.

Scores of the applicants on the fifty core items were significantly lower than those of either supervisory level from any plant in all comparisons but one. With only one exception, this difference obtained even when education was held constant. Thus, in accordance with the hypothesis, a steady increase of scores occurred from job applicants through "poorer" (Level 1) to "better" supervisors and suggests possible usefulness of such a measure in a battery for supervisory selection.

To reduce the ambiguity and length of the test and increase its reliability, the writer eliminated the twenty general and twenty supervisory items lowest in power to discriminate between high- and low-scoring supervisors and/or lowest in test-retest reliability (as determined from reliability data obtained on college students). Supervisors' tests were rescored for the retained items only; little if any loss in power to differentiate between the supervisory levels appeared as a result of this shortening.

An extensive review of selected literature on related topics and a 267-item bibliography are included.

Microfilm \$3.45; Xerox \$12.15. 267 pages.

## WORD KNOWLEDGE OF AN INDUSTRIAL POPULATION

(L. C. Card No. Mic 60-3556)

Sanford Norman Hotchkiss, Ph.D.  
University of Minnesota, 1959

Adviser: Donald G. Paterson

In an effort to aid communication with rank-and-file employees, the relationships between educational, social and demographic characteristics and word knowledge and usage were studied within a defined industrial population. Specific purposes and hypotheses covered type and extent of relationships anticipated as well as the development of measuring instruments appropriate for that population.

Test construction followed a frequency count of circa 172,000 words drawn from industrial house organs and employee notices to provide 1500 words which met established criteria and were graded by the Thorndike-Lorge list. Two hundred words drawn from this list provided stimuli for items in three multiple-choice questionnaires.



Forms A and B were constructed to be equivalent. Form C, of equal fifty-item length, contained the remaining fifty words as correct alternatives. Stimulus words were arranged by increasing grade level with from one to four correct alternatives for each. A pilot study showed that indicating choice by checking correct alternatives, checking incorrect alternatives, or crossing out incorrect alternatives led to no significant differences in scores.

These forms were administered in a CA-CB sequence to 245 volunteer applicants of both sexes at the Minneapolis and St. Paul offices of the Minnesota State Employment Service and at General Mills Mechanical Division. Over half the respondents were high school graduates and were primarily young entrants to the job market. Women comprised a third of the total sample and a majority at General Mills.

Intensive analyses of score distributions are presented by sequence, form, source, and sex. Comparisons of means and variances revealed significant differences between Form C and A or B, precluding pooling data. Discussion includes appropriate statistical treatment of all subgroups. Differences in scores for Forms A and B were unrelated to population characteristics and led to analysis of item construction to identify test variables contributing to uniqueness. Reliability of the measuring instruments is treated in detail. Manner of construction precluded meaningful measures of internal consistency and the forms did not meet Wilks'  $L_{mvc}$  test of equivalence. Form C showed a correlation of .80 and .85 with Forms A and B. Test-retest with subgroups of 68 college students showed little practice effect and correlations of .63 to .83 for pages, .79 to .89 for forms, and .84 to .90 for sequences. It was concluded that these questionnaires were promising instruments for measuring word knowledge and usage in an industrial population.

Trend analysis showed a significant tendency toward higher scores with increased education. Source and sex were inconclusive. No significant trend was found for age, total years worked, or time on last job. Analysis by standard deviation units confirmed the trends and added indication of differences among forms. The effect of educational level appeared moderated by highly unique characteristics of individual items. There were no sharp breaks by stimulus level and only general trends by alternative level, varying by form. Much of the interaction of stimulus and alternative appeared unaccounted for in terms of variables investigated. Correlations by alternatives showed high similarity of response pattern for similar sources and adjacent educational levels.

An integral part of the study is an extensive review of the literature on word lists, measurement and correlates of vocabulary, and development of readability measures. A 310-item bibliography is included.

Microfilm \$5.05; Xerox \$18.00. 396 pages.

## INTERESTS AS A PREDICTOR OF GRADUATION IN ENGINEERING

(L. C. Card No. Mic 60-4188)

Eugene Cunliffe Mayfield, Ph.D.  
Purdue University, 1960

Major Professor: Joseph Tiffin

This study was undertaken in order to answer several questions concerning the engineer scale of the Strong Vocational Interest Blank (SVIB). First, did the SVIB engineer scale predict the graduation of engineering students at the time it was revised in 1938? Second, would a scale developed specifically for the purpose of differentiating mechanical engineering graduates from nongraduates prove to be superior to the SVIB engineer scale? Third, have such scales retained their predictive validity over a twenty year time period?

The raw data for the first part of the investigation consisted of SVIBs which had been administered to engineering freshmen at Purdue University in 1935. Fifty blanks were obtained for each of the following groups: mechanical engineering graduates, electrical engineering graduates, chemical engineering graduates, and students who entered the engineering curriculum but who were not graduated. Forty-one blanks were obtained for students who were graduated in civil engineering.

In order to determine the ability of the SVIB engineer scale to differentiate engineering graduates in general from nongraduates, a  $t$  test was run comparing the 191 students who were graduated to the 50 nongraduates. An analysis of variance was then applied to determine whether or not the predictive validity of the SVIB engineer scale was specific to certain majors within the Schools of Engineering.

By means of item analysis, a scale was then developed from the SVIB specifically for the purpose of predicting the criterion of graduation in mechanical engineering. The criterion groups for the item analysis consisted of 100 blanks for mechanical engineering graduates and 100 blanks for nongraduates. The resultant scale was analyzed in the same manner as was the SVIB engineer scale. In addition, a point biserial correlation was computed between the item analyzed (IA) scale and the criterion of graduation in mechanical engineering. The resultant coefficient was compared to that obtained for the SVIB engineer scale with respect to the same criterion.

The next step was to determine whether the two interest scales added to the prediction of graduation in mechanical engineering provided by academic aptitude and achievement tests. For this purpose, the Wherry-Doolittle technique was applied to five predictors; the two interest scales and three orientation tests the students had taken upon entrance to the University.

The two interest scales were then investigated with respect to their retention of validity over a twenty year time period. Two criteria were used in this investigation. The first was the grade point average of engineering students who entered Purdue University in 1959. The second was graduation in mechanical engineering for students who entered the University of Minnesota in 1954.

The results obtained from the above analyses led to the following conclusions:

1. The SVIB engineer scale, at the time it was current, did differentiate those Purdue University students who were graduated with an engineering degree from those students who were not graduated but did not differentiate equally well for each field of engineering.
2. The IA scale was at least as good as, and probably superior to, the SVIB engineer scale in differentiating mechanical engineering graduates from nongraduates.
3. The IA scale was not identical to the SVIB engineer scale or any of the other SVIB occupational scales. In addition, the IA scale added significantly to the prediction of graduation provided by standard mental aptitude and achievement tests.
4. The IA scale appeared to retain some degree of predictive validity over a twenty year time period with respect to the criterion of grade point average for students at Purdue University. Neither the IA scale nor the SVIB engineer scale was significantly related to the criterion of graduation in mechanical engineering for students who entered the University of Minnesota in 1954.

Microfilm \$2.50; Xerox \$5.20. 102 pages.

#### THE USE OF SURFACE EXPLORATION DESIGNS IN PSYCHOLOGICAL RESEARCH

(L. C. Card No. Mic 60-4195)

James Charles Naylor, Ph.D.  
Purdue University, 1960

Major Professor: E. J. McCormick

Many times limitations are placed upon an experimenter in terms of time and money, so that he becomes restricted as to the number of observations that he may make in a particular investigation. As a possible solution to this problem several methods have been developed. One of these, "the method of steepest ascent," has been quite successful in the context of chemical research. Essentially the procedure involves the using of a small number of observations to obtain an estimate of the relationships that exist between the independent and dependent variables. Once this has been achieved, these estimates are then used to plot a path, descriptive of the changes necessary in each independent variable to increase yield. The experimenter moves along this path, taking a series of observations. When the yield ceases to increase, another small experiment is conducted to determine 1) whether a new path is necessary, or 2) whether a "true" maximum has been obtained, i.e., this particular location represents the optimum combination of treatment variables.

This study attempted to gain an initial evaluation of the technique when used in a psychological experiment, where the experimental unit (a human being) typically has a good deal of inherent variation. The study consisted of three separate phases.

Phase I examined the method in a psychomotor task, where there was no interaction between the variables.

The method was quite satisfactory in that the paths were reliable and led to maxima, and the attainment of a maximum was clearly indicated by shifts in the values of the beta weights and  $R^2$ .

Phase II used the same task, but with different variables so that there would be interaction present. Again the method led to a maximum, but the paths were less consistent. However, the final maxima obtained by the paths were in close agreement in terms of location and yield. Again the values of  $R^2$  and the beta weights dropped near the maximum.

Phase III utilized the method in the context of a psychophysical task requiring judgments of tone duration. This phase indicated the importance of the size and the location of the initial design. Small designs tend to mirror local surface fluctuations, large designs more accurately estimated the complete surface.

In general, the method of steepest ascent was considered to have behaved in a manner that was consistent with its performance in other scientific disciplines. Therefore whenever there are limitations placed upon an experiment in terms of the number of possible observations this procedure should be considered as a possible means of data collection and analysis. However, the experimenter should keep in mind the limitations which are always present when the number of observations are reduced, and by proper selection of the size of the experimental unit and the starting point attempt to minimize these limitations.

Microfilm \$2.50; Xerox \$6.20. 128 pages.

#### THE HISTORY, DEVELOPMENT, PRESENT STATUS, AND PURPOSE OF THE FIRST (INTRODUCTORY) COURSE IN PSYCHOLOGY IN AMERICAN UNDERGRADUATE EDUCATION.

(L. C. Card No. Mic 60-2669)

Gabriel Darrow Ofiesh, Ed.D.  
University of Denver, 1959

The purpose of the study was to trace the historical development of the first (introductory) course in psychology in American undergraduate education and to determine the present (1957-1958) status of the course in the American college and university. The following questions were implicit in this study:

1. What has been the history of the development of psychology education on the undergraduate level and particularly on the introductory course level in American college education?
2. To what extent has the introductory psychology course in most institutions of higher learning on an undergraduate level been considered a terminal course by such institutions and treated as such?
3. What, in general, have been the content and purpose of the introductory course in psychology in American undergraduate education?
4. What is the present philosophy of education surrounding the introductory psychology course at most undergraduate institutions in American education?



During the early period in Colonial America, psychology education was a significant part of the subject matter of physics and logic. In the late seventeenth and early eighteenth centuries, it was dominated by theological considerations. Influential figures during the Colonial period were Samuel Johnson, Jonathan Edwards, John Daniel Gros, John Witherspoon, Samuel Stanhope Smith, Levi Hedge, Benjamin Rush, Frederick Beasley, Asa Burton, and Thomas Upham. Upham's text was, however, the most noted and influential book in mental philosophy and was considered by some historians the most comprehensive psychological treatise until William James wrote his *Principles*.

During the period of German transcendentalism, the courses in mental and moral philosophy were taught by men who were jointly clergymen and college presidents. Psychology was one of the most important subjects in the curriculum and was shifting in its perspective and frame of reference away from mental and moral philosophy. During the decades of transition (1880-1900), the content became less intimately concerned with a content which was physiological and experimental in its orientation. Methodology became of greater concern than content. Psychological laboratories developed in numerous schools and had extensive impact on the introductory programs.

From the beginning of the twentieth century until the present (1957-1958), the "new psychology," with its emphasis on the scientific and experimental, had taken firm hold. This period also witnessed the development of some effort to make the first course in psychology a meaningful one to the student. Texts were written to meet this goal, and courses were planned accordingly. The basic question that was asked, however, was whether the first course in psychology should be a terminal course, designed to be of service to the student and to assist him in the solution of life's problems, or whether it should be a subject-matter, scientific-oriented course, seeking primarily to teach the facts and theories of scientific psychology.

The great majority of trends in the liberal arts colleges led to structuring the first course in psychology to emphasize scientific methodology, experimental psychology, and the facts and theories of scientific psychology. In the majority of the universities, however, the first course in psychology was primarily a subject-centered course, oriented toward scientific methodology and experimental psychology. The utilization of the psychological laboratory in conjunction with the first course was more prevalent in the university than it was in the liberal arts college.

On the other hand, there appeared to be a greater emphasis in the university on the personal adjustment and service-oriented course than there was in the liberal arts college. There also appeared to be a more significant concern with structuring the first course in the university to meet the needs of general and liberal education.

In the engineering and technical schools, half of the schools in the sample felt that the course should be subject-matter centered, and the other half felt that it should be student centered and directed primarily toward the professional needs of the students. The effort to make the first course in psychology meaningful to the student with respect to professional and personal needs was most apparent, however, in the teacher education college where only one of the small sample of ten colleges surveyed admitted to a subject-matter-oriented first course in psychology.

It was recommended that psychology departmental staffs determine:

1. the extent to which the first course in psychology should be structured to correlate its aims and purposes with those of the institution;
2. the extent to which the first course in psychology should provide a service function to the student and how it should be structured in this respect;
3. the relationship between the first course in psychology and other courses in the core curriculum of the undergraduate student;
4. the function of academic freedom and the extent to which the first course should be standardized within an institution;
5. the extent to which the first course should be structured as a terminal course;
6. the basic concepts which should be emphasized in a terminal course;
7. the relationship between the first course and the major student; and
8. the relationship between the first course and the professional and academic interests of the instructors.

Microfilm \$9.60; Xerox \$34.15. 757 pages.

#### THE DIFFERENTIAL EFFECTS ON EXTINCTION OF FIVE REINFORCEMENT SCHEDULES

(L. C. Card No. Mic 60-4259)

Michael Henry Siegel, Ph.D.  
Rutgers University, 1960

Major Professor: Dr. Donald G. Forgays

An experiment was conducted to investigate the effects on extinction of schedules of delayed reinforcement and the differential effects upon extinction of delayed reinforcement as compared with differential reinforcement of low rates.

The subjects were forty-eight naive albino rats. The apparatus was a modified Skinner box. There were five different experimental groups. Two groups were maintained in acquisition on a DRL schedule, two were maintained on a delayed reinforcement schedule, and one was maintained on an immediate continuous reinforcement schedule. One of the DRL groups and one of the delayed reinforcement groups were delayed for five seconds, while the other two were delayed for fifteen seconds. Three other groups were not reinforced with food during acquisition and served as operant level comparison groups for the five experimental groups.

All subjects received sixty half-hour acquisition sessions at one session per day, although only the last fifteen sessions were analyzed. The subjects entered the apparatus under 23.5 hours of food deprivation. Following acquisition, each experimental subject was given fifteen half-hour extinction sessions at one session per day.

The response measures analyzed were the number of reinforced panel presses per session and the latency of the first press per session.

The results were marked by great response variability which generally precluded finding statistical significance through analysis of variance techniques. An analysis of group ranks and totals were used both for acquisition and extinction scores and for an extinction score which had been adjusted for the number of reinforcements received during acquisition. Trend analyses were performed on the latency and press scores across extinction trials.

The results revealed that during acquisition the fifteen second groups and the delayed reinforcement groups did not learn as well as either the five second groups or the DRL groups and that during extinction the fifteen second groups and the delayed reinforcement groups displayed more resistance to extinction than the five second or the DRL groups. These findings were consistent with predictions made by contiguity theory and discrimination theory.

The results were partly a function of the response measure employed. It was suggested that the latency and press scores actually were indicators of two different habits. Amsel's frustration position was discussed in reference to the extinction pattern of the latency scores.

The results were assessed in terms of several theoretical positions. It was concluded that a broadly interpreted discrimination theory could best account for the findings. Microfilm \$2.50; Xerox \$5.00. 96 pages.

#### THE RELATIONSHIP OF PLACEMENT READINESS TO PLACEMENT SUCCESS

(L. C. Card No. Mic 60-3761)

Nancy Duncan Stevens, Ph.D.  
New York University, 1960

Chairman: Professor Milton Schwebel

This study explored the relationship of placement readiness to placement success. To measure this relationship, the following four scales were constructed:

- (1) The Placement Readiness Scale, a ten dimensional, five-point scale, constructed from a pilot study and the Ginzberg theory of occupational choice, for purposes of measuring the quality of client responses;
- (2) The Over-all Impression Placement Readiness Rating, a single five-point scale for rating the interviewer's impression of the client's over-all placement readiness;
- (3) The Placement Prediction Scale, a single five-point scale to measure the interviewer's predictions on client placement readiness;
- (4) The Placement Success Scale, a seven dimensional scale with two-points on two dimensions and three-points on five dimensions, constructed to measure actual placement success in terms of the field, level, geographic location, and the salary of the job obtained and the specific time taken to obtain it.

It was hypothesized that the characteristics of placement readiness have a significant relationship with placement

success when placement readiness is identified by experienced interviewers and when placement readiness is evaluated in terms of obtaining a job on the desired institutional level, in a desired geographic locale, at a desired salary level and within a specified period of time. A randomly selected population of one hundred alumni and students of New York University were interviewed by four interviewers in the Education Division of the University Placement Services. The Chi-Square Test was used to test the significance of the relationship of the levels of placement readiness identified by each scale with the level of placement success obtained.

It was found that:

- (1) The Placement Readiness Scale successfully predicted placement success on three-out-of-three levels; high, moderate, and low.
- (2) The Over-all Impression Readiness Rating successfully predicted the placement success only for those individuals with high placement readiness. This succeeded on only one-out-of-three levels.
- (3) The Placement Prediction Scale successfully predicted placement success for individuals who obtained high and low placement success. It succeeded on only two-out-of-three levels.

The Standard Error of the Difference Between Uncorrelated percentages was used to test the differences between these scales to successfully predict placement success. It was found that there was no significant difference of one scale over another in its ability to predict placement success.

It is therefore concluded that:

- (1) Placement success may be predicted.
- (2) Placement success is predicted most successfully when the level of client placement readiness is successfully identified by an analysis of client responses on a multi-dimensional scale, the Placement Readiness Scale.
- (3) The degree of crystallization concerning desired field, desired geographic location, institutional level and desired salary level is significantly related to placement success.
- (4) The level of placement readiness is a significant factor in the level of placement success.

Microfilm \$2.50; Xerox \$8.00. 171 pages.

#### A COMPARISON OF THREE TYPES OF WORK ACTIVITY STATEMENTS IN TERMS OF THE CONSISTENCY OF JOB INFORMATION REPORTED BY INCUMBENTS

(L. C. Card No. Mic 60-4219)

Keith Benjamin Tombrink, Ph.D.  
Purdue University, 1960

Major Professor: E. J. McCormick

When using a check list as a means of obtaining information about work activities, one is faced with several



problems concerning the type of activity statement that should constitute the check list. One important consideration in this regard is the reliability or consistency of the information obtained. Hence, this study was conducted for the primary purpose of comparing three different types of work activity statements (tasks, elements, and work actions) in terms of the consistency of job information obtained through their use in check lists. Definitions of the three types of statements were prepared and formulated as syndromes of the characteristics of each type. Two Air Force maintenance jobs, one of a radar mechanic and the other of a jet engine mechanic, were analyzed to obtain job content information for experimental use. A description of each job was prepared, and in so doing, each activity statement was initially classified into one of the three types. A large sample of individual activity statements of each type was then selected at random from each description.

A number of persons engaged in the training of incumbents in the two jobs served as judges in classifying the samples of activity statements. The main purpose for obtaining these classifications was to evaluate the suitability of the statement definitions by determining the extent to which the judges could agree among themselves in rating the activity statements. In addition, their classifications were used as a basis for selecting statements for inclusion in subsequent experimental check lists.

A sample of 50 activity statements of each type was selected from those classified with the greatest amount of agreement by the judges, and incorporated into a check list. Each check list was then used in conjunction with eight scales designed to obtain job information on seven different variables. Four of the scales yielded quantitative information, i.e., 1. the frequency of the performance of activities, 2. the time required for the performance of activities, 3. mental difficulty, and 4. physical difficulty. The other scales (5 to 8), each of which constituted only a nominal level of measurement, yielded information about: 5. type of training received, 6. type of training desired, 7. type of assistance obtained, and 8. the reporting periods of the frequency scale. The check lists were assembled into booklets and administered to incumbents and supervisors in the two experimental jobs. A second questionnaire was administered to each subject one week after the first for purposes of test-retest analysis.

The data reported in the questionnaires were analyzed with respect to the following three indices of consistency: The test-retest reliability of scale responses; the test-retest reliability of reports about the occurrence or nonoccurrence of activities; and the inter-rater consistency of the scale responses. A series of analyses of variance was then run for each index, and all results were interpreted in light of the general patterns of significant effects.

It was found that the test-retest reliability of responses on the four quantitative scales in the study was higher for tasks and elements than for work actions. The responses on the four qualitative scales, however, were in general more reliable for work actions than for tasks, with elements being significantly different from neither of the other two. There was a slight trend for tasks to be more reliable than work actions on all scales in regard to the occurrence index, with elements again falling between the other two and being significantly different from neither of them. The inter-rater consistency analyses showed a slight trend for a significant difference between tasks and

the other two types of statements when used with the quantitative scales, with the difference being in favor of tasks. When used with the qualitative scales, the types of statements appear to be ranked as work actions, elements, and tasks, from the highest to the lowest in terms of inter-rater consistency.

Various differences were found in the other three factors of the experiment; scales, jobs, and raters. In certain instances, rather strong trends of differences emerged both among scales and between the two jobs, but for all practical purposes, there was no systematic difference between incumbents and supervisors in reporting information about incumbents' work.

Microfilm \$2.50; Xerox \$8.40. 184 pages.

## PSYCHOLOGY, CLINICAL

### DISTRACTIBILITY IN PSYCHIATRIC PATIENTS AS A FUNCTION OF PERSONAL-SOCIAL ORIENTATION AND ESCAPE FROM AN AVERSIVE STIMULUS

(L. C. Card No. Mic 60-4166)

Thomas Stephen Eliseo, Ph.D.  
Purdue University, 1960

Major Professor: John M. Hadley

The present study was concerned with the performance of groups of normal, delusional, and hallucinatory individuals on a verbal concept sorting task involving attention (or non-distractibility). It was hypothesized that performance was a function of personal-social orientation and motivational conditions. The study was derived from two sources. One was the attempt to study the behavioral characteristics of patients classified as "schizophrenics" rather than "schizophrenia" *per se*. The behavioral characteristics of particular interest were delusions and hallucinations. The other source was the effect of a motivational condition (i.e., escape from an aversive stimulus) upon the usual deficit in performance on reaction time, learning, and conceptual tasks shown by individuals exhibiting schizophrenic reactions.

The psychiatric subjects were fourteen predominantly delusional and seventeen predominantly hallucinatory individuals, selected by means of ward behavior ratings. Fourteen patients in the medical and surgical wards of a VA hospital, with no known history of a psychotic or neurological disorder, served as a comparison normal group. All subjects were males and were equivalent in age and number of years of schooling completed. The psychiatric patients were also equated for number of years hospitalized.

A verbal concept sorting task was used. The concept was given to the subjects by the experimenter. Therefore, the task involved only that the subject pay attention to sort correctly. Each subject served in the two experimental conditions - the control (i.e., the usual testing situation) and the noise (i.e., an escape from an aversive stimulus situation). The aversive stimulus was an intense white noise. Six equivalent sorting tasks were used - three in

the control and three in the noise condition. The order of presentation of tasks was randomized. The experimental conditions were counterbalanced for order of presentation. Half of the subjects in each experimental group received the control condition first, the remaining half the noise.

The general hypothesis of the present study was supported. In the control condition, the performance of the normal group was best, while that of the delusional was intermediate and of the hallucinatory poorest. Contrary to expectation, the performance of the hallucinatory group did not improve in the noise condition, while that of the delusional group was equivalent to the normal group only in the noise condition. These results were obtained when performance was measured both for accuracy and accuracy plus speed. The experiment was interpreted as supporting the view of differences in distractibility and in reaction to an aversive stimulus between delusional and hallucinatory psychiatric patients. On the one hand, although the delusionals were significantly less distractible than the hallucinators, the performance of the delusionals improved in an escape from an aversive stimulus situation, such that it was equivalent to a normal group's performance. On the other hand, the hallucinatory subjects remained as distracted in the noise as in the control condition.

The differences between delusional and hallucinatory patients were related to the studies of psychiatric patients rated as "process" versus "reactive schizophrenics" and as "schizophrenics" exhibiting a "good" versus a "poor" premorbid history.

Microfilm \$2.50; Xerox \$3.80; 66 pages.

#### AN EXPLORATION OF DEVELOPMENTAL ASPECTS OF BODY SCHEME AND OF IDEAS ABOUT ADULTHOOD IN GRADE SCHOOL CHILDREN

(L. C. Card No. Mic 60-4325)

Jeanne Eloise Fish, Ph.D.  
University of Kansas, 1960

Various discussions have appeared in the literature which deal with the child's construction of himself as an adult. At the beginning of this study it was pointed out that there is little empirical evidence to support or fill in the outlines of developmental theories in this area. The present research attempts to explore selected relationships which may exist among several measures of body scheme development, the child's ideas of what adulthood is like, and the temporal perspective in which he placed those adult criteria he had selected.

A total of 71 Ss were used, 21 seven-year-old boys, 25 nine-year-old boys, and 25 eleven-year-old boys, of average or better intelligence.

It was hypothesized that perceptual indices of body scheme development could be found in (a) reaction to aniseikonic distortion of S's mirror image and of an observed object, (b) Barrier score on a multiple-choice Rorschach (according to Fisher and Cleveland, 1958), and (c) estimation of S's own height.

The procedures for gathering information concerning ideas of adulthood were: (a) S tells a "story" about how the S expected to know when he was grown up, (b) S volun-

teers in stating the three most important ways for judging adulthood that he had given in the story (Three-Criteria Task), (c) ten adulthood criteria are presented and S selects the three most important ones (Adult Criteria Scale), and (d) S first draws a human figure representing himself now and then another figure representing himself as an adult.

To assess the temporal perspective in which the Ss placed certain events characteristic of adulthood, they were asked to mark the event off on a line representing their life span (e.g., when grown up, married, work), to indicate its temporal distance and the age at which they expected it to occur.

It was expected that the positive reaction to aniseikonic distortion, the accuracy in estimating height, and the Barrier scores would all increase with increasing age. Statistically reliable relationships among these perceptual indices of body scheme were also expected. Additionally, expectations were (a) that the perceptual indices of body scheme development would relate positively to maturity ratings of the ideas of adulthood and to the temporal judgments; (b) that the maturity ratings of the ideas of adulthood would increase with increasing age; (c) that the older Ss would be more "realistic" than the seven-year-olds in assigning ages and distances to the temporal judgment items.

The results support the expectations to the following extent:

1. Of the perceptual indices, only the aniseikonic experiments differed as hypothesized with increasing age.
2. In the ideas of adulthood and in the drawing of an adult, the tendency to utilize "psychologically more mature" criteria for indicating adult status increased with increasing age.
3. Differences among the seven-, nine-, and eleven-year-olds as to the ages or distances assigned to adulthood events were not significant. The "accuracy" with which ages were assigned to future events tended to improve with increasing age. Also the psychological distance to adulthood tended to increase with increasing age.
4. The total patterning of the data suggests the tentative generalization: the child whose body scheme is less differentiated or articulated presents relatively less mature criteria for judging adulthood in his story, and he experiences adulthood as psychologically near. The child whose body scheme is relatively more articulated presents relatively more mature criteria for judging adulthood in his story, and he experiences adulthood as psychologically more distant from him.

The exploratory and empirical nature of the present study left many questions unanswered and suggests other means for exploring with more precision the possible relationships which have been under scrutiny.

Microfilm \$2.50; Xerox \$8.00. 171 pages.



THE RELATIONSHIP BETWEEN CERTAIN  
RORSCHACH INDICATORS AND THE  
MAGNITUDE OF KINESTHETIC AFTER-EFFECT

(L. C. Card No. Mic 58-7585)

Martin H. Goldstone, Ph.D.  
Yeshiva University, 1958

A basic hypothesis was derived from empirical findings on earlier research and predictions as to the direction and strength of variance between the two tests were made from Witkin's field theory and Klein and Schlesinger's concept of the ability to tolerate ambiguity. The methodology utilized multiple correlation analysis. Sixty male adolescent heroin addicts served as subjects. Three measures were obtained: a) Rorschach determinants, b) KAE magnitude for 30, 60, and 90 seconds, c) KAE magnitude for 30, 60, 90 seconds on the following day. The results supported the basic hypothesis. It was demonstrated that a) KAE magnitude covaries with Rorschach determinants, b) KAE magnitude varies negatively with pure form (F) responses, c) KAE magnitude varies negatively with movement (M, FM, m) responses d) KAE magnitude varies insignificantly with color and shading responses. The general conclusion was that some central variable probably underlies behavior in diverse phenotypical situations, probably relating to stimulus ambiguity and individual style in coping with ambiguity. In making predictions of behavior from personality variables, knowledge of the tendency to react in a controlled fashion as well as the tendency for reflective behavior are considered more valuable than knowledge of the tendency to respond to stimuli that are affectively-toned. Microfilm \$2.50; Xerox \$4.20. 78 pages.

A STUDY OF ACCESSIBILITY  
TO GROUP THERAPY OF A GROUP OF  
INCARCERATED ADOLESCENT OFFENDERS

(L. C. Card No. Mic 60-3749)

Irving Jacks, Ph.D.  
New York University, 1960

Chairman: Professor H. H. Giles

The purpose of the study is to investigate a method of determining accessibility to group therapy among a population of offenders aged 16 to 21 and incarcerated in a short-term penal institution. A review of the related literature pointed up the concern of psychotherapists with the problem of selecting patients, the particular significance of treatment accessibility problems in penal settings, and the lack of validated instrumentation for selecting accessible patients prior to beginning therapy, despite considerable agreement, on a clinical level, regarding selection criteria. This study is an attempt to objectify the intuitive impressions of clinicians.

Subjects were 68 boys sentenced to the New York City Correctional Institution for Men, who were assigned to therapy groups on a consecutive nonvoluntary basis shortly after admission, if they met the necessary criteria.

An initial pool of 179 statements of attitude and self-description was selected, based on the literature of group

therapy and suggestions by experienced group therapists. Six psychologist-judges, employed in the New York City Department of Correction, rated each item on a five-point scale of relevance to group therapy accessibility. The ratings for each item were summed, and the items ranked according to summed rating; 83 items with the highest summed ratings were retained. The six judges then sorted these 83 items into a "forced normal" distribution of nine steps from least to most accessible, thereby yielding item-weights for scoring the scale. The weight for each item depended on whether it was answered "I agree" or "I do not agree." The sum-total of weights for all the items, divided by ten and rounded to the nearest whole number, gave the individual subject's "Accessibility Scale score."

Prior to his first therapy session, each subject's accessibility to group therapy was rated on a five-point scale, on the basis of, respectively, a psychiatric interview, an interview with his therapist, and a battery of projective psychological techniques. In addition, he was given the Accessibility Scale. Thus, there were four independently-determined predictors of each subject's accessibility. Following the twelfth session of therapy, each subject was again given an accessibility rating by his therapist; this constituted the criterion measure.

Product-moment correlation coefficients were obtained: psychiatric interview-.156; psychological testing-.319; therapist's pretherapy interview-.352; Accessibility Scale score-.570. All but the psychiatric interview were significant at the 1%-level of confidence.

By means of "Z" transformation technique, the coefficient obtained with the Accessibility Scale was tested against each of the other three predictors, respectively, for significance of differences. The differences were all significant at the 1% or 5%-level of confidence.

These results make tenable the hypotheses that: (a) a scale could be developed which would successfully predict accessibility to group therapy in the subject population, and; (b) that such prediction would be significantly more accurate than those obtainable with the other three methods currently in clinical use.

By implication, the study demonstrates the feasibility of taking the intuitive insights on practicing clinicians as a basis for developing valid instrumentation for the objective selection of patients accessible to psychotherapy. This would be particularly desirable in mass treatment settings where the supply of clinical workers is chronically insufficient.

Remaining for further research are the following: item-analysis in order to heighten the diagnostic power of the scale; cross-validation to test the possibility of the present results being fortuitous; and, finally, content-analysis of scale-items as a basis for expanding theoretical knowledge regarding treatment accessibility.

Microfilm \$2.50; Xerox \$7.40. 156 pages.

# OCCUPATIONAL PRESTIGE IN TWO VETERAN'S ADMINISTRATION HOSPITALS

(L. C. Card No. Mic 60-3557)

James Ray Kiland, Ph.D.  
University of Minnesota, 1959

Major Adviser: Donald G. Paterson

This study had two primary goals. First, to determine the nature and extent of prestige differences within a restricted range of occupations. It was the author's contention that previous research on occupational prestige could be questioned since it typically involved the judgments of prestige differences among a wide range of occupations by judges who had no first-hand familiarity with the occupations they were being asked to rate. Second, to provide descriptive information on the status of medical and paramedical specialties. While such information was available it was based almost exclusively on speculation, relationships with income or organizational charts, or on sociological-anthropological approaches using participant observers and semi-structured interview techniques rather than the ranking method characteristically used by psychologists for the study of occupational prestige.

A list of 23 hospital occupations was developed. The job titles, with parenthetical job descriptions, were listed in alphabetical order on a rating sheet with the instructions that they be placed in rank order according to which the judge "looked up to" the most. The questionnaire and a covering letter were distributed to 470 employees in a general medical hospital, and 233 employees in a neuropsychiatric hospital, who were engaged in the occupations being studied. After two follow-ups a total of 92 per cent of the GM&S sample and 92 per cent of the NP sample returned their forms. The usable return from the two hospitals was 78 per cent and 82 per cent, respectively. The majority of unusable questionnaires were returned not completed with comments to the effect that it was impossible or inappropriate to make the required discriminations since the jobs could not be differentiated on the basis of prestige.

Statistical analysis resulted in the following findings:

(1) There was statistically significant agreement among the status hierarchies of individual employees in both hospitals.

a. Substantially more unanimity of opinion was found for the location of some occupations in the status hierarchy. Quartile deviations for the distribution of ranks assigned an occupation ranged from .6 to 6.4.

b. Except for four occupations at the upper extreme of the GM&S hierarchy ("Ward Physician", "Surgeon", "Psychiatrist", and "Registered Nurse") and two occupations at the upper extreme of the NP hierarchy ("Psychiatrist", and "Ward Physician") the ratings of occupations overlapped to such an extent that little practical significance could be attributed to the differences between them.

(2) General agreement was found among the status hierarchies of the occupational sub-samples in both hospitals. The extent of association, however, was not nearly as great as that typical of previous research when hierarchies derived from different groups have been compared. Only 11 per cent of the Rho's in the GM&S

hospital correlation matrix, and 1 per cent of the NP sub-sample intercorrelations, exceeded .89, while 16 per cent and 8 per cent of the correlations were not statistically significant in the two hospitals, respectively. Those groups which were most similar with respect to treatment orientation exhibited the greatest association among their status hierarchies while the non-significant relationships were generally found between groups whose orientation was thought to be markedly dissimilar.

a. Without exception, members of an occupation afforded it higher status than did the sample as a whole. In the majority of cases, subjects also tended to upgrade the status of occupations which were similar to their own.

b. Judges within a specific occupational sub-sample demonstrated greater association among their ratings than was found among individuals comprising the total samples in every case but two. The highest inter-judge agreement occurred in those groups which were most homogeneous with respect to training, duties, and treatment philosophy and which were relatively isolated from the main stream of hospital activity.

Microfilm \$3.20; Xerox \$11.05. 245 pages.

# AN EXPERIMENTAL INVESTIGATION OF EXHIBITIONISM AND SCOPTOPHILIA

(L. C. Card No. Mic 60-3417)

Paul Birely Koons, Jr., Ph.D.  
Michigan State University, 1960

Major Professor: Albert I. Rabin

This study was undertaken as the initial stage in the empirical investigation of the psychoanalytic concepts of the psychosexual impulses of exhibitionism and scopophilia. Both impulses are given the status of components of the sexual impulse by Freud (1938); exhibitionism is defined as taking pleasure in the display of the genitals, scopophilia is defined as the sexualization of the sense of sight. A review of the literature indicates that, while these two impulses have been used in the dynamic explanation of a wide variety of behaviors both normal and neurotic, there have been no experimental studies to support the several, and often contradictory conceptualizations of the two impulses.

A modification of Blum's (1954) design for producing perceptual vigilance and defense was employed to test the hypotheses that the presence in the environment of cues suggestive of the impulses of exhibitionism and scopophilia would arouse vigilant and defensive behavior depending on the level of awareness at which the cues were presented.

Four groups of ten subjects under the conditions: Vigilance-exhibitionism, Vigilance-scopophilia, Defense-exhibitionism, and Defense-scopophilia, were presented with a series of critical and neutral stimulus pictures tachistoscopically.

The results clearly confirm the hypotheses. Additional data was collected in the attempt to isolate the specific stimulus factors involved. The data from a control group narrowed the factors to the verbal statements used to sensitize the subject to the visually presented cues. Two further control groups were employed in an attempt to



determine which aspects of the verbal statements were crucial in the confirmation of the hypotheses.

The results were interpreted as lending support to a preliminary operational definition of exhibitionism and scopophilia. A more complete definition was offered as the foundation for a program of future research on these concepts.

#### References

Blum, G. S. An experimental reunion of psychoanalytic theory with perceptual vigilance and defense. *J. abnorm. soc. Psychol.*, 1954, 49, 94-98.

Freud, S. Three contributions to the theory of sex. (Brill translation) New York: Modern Library, 1938. Microfilm \$2.50; Xerox \$4.00. 73 pages.

#### RELIABILITY OF TECHNIQUES FOR SCORING T.A.T. RESPONSES AND RATING PREDICTED EXECUTIVE BEHAVIOR: A STUDY OF ADVERTISING AGENCY EXECUTIVES.

(L. C. Card No. Mic 60-4770)

Eliezer Krumbein, Ph.D.  
Northwestern University, 1960

#### PURPOSE

The purpose of the study was to determine the reliability of two instruments for scoring and rating Thematic Apperception Test (TAT) protocols using intra-class correlation to establish reliability. This was a preliminary step in a study of the personality of 104 successful and promotable advertising agency executives. In addition:

1. The extent of association among ten items of information descriptive of the executives and their employing agencies was determined, using two-way product moment correlations.
2. An attempt was made, through an analysis of variance, to predict an executive's employment in an agency of given size; whether he was included in the reliability sample (N = 52) or the balance of the sample; and the extent of interaction between agency size and research groups for each item of identifying information.

#### INSTRUMENTS

The following, self-administering, data collecting instruments were employed:

1. Executive Personality Evaluation: The Henry-Moore Test of Thematic Production. Chicago: Social Research, Inc., 1956.
2. Strong Vocational Interest Blank for Men, Form M.
3. Clark-Northwestern Analogies Examination, Form C, by Edward L. Clark, Northwestern University.
4. Agency fact sheet, devised by the author.

The author developed two guides for analyzing TAT data:

1. Scoring guide for TAT responses. The guide was based on an outline by Carson McGuire. It provided from two to six nominal choices in each of ten nominal categories for each story. Judges made forced selections within each category of the nominal choice which best characterized the psychodynamics of the story. Ten scores were made for each story; or 100 scores for each ten story protocol.
2. Rating guide for predicted executive behavior. The guide was based on hypothesized behavior suggested by William E. Henry. It provided twenty-five statements of predicted executive behavior. Judges rated each characteristic on a scale from zero to four, from absence of the characteristic to its strong presence, based on their assessment of a total ten-story protocol.

#### CONCLUSIONS

Executives in the sample were, by a number of criteria, successful, intelligent, occupationally stable, well educated, youthful men with high aspiration levels, employed by outstanding agencies.

Personal and identifying information was normally distributed among the men in the sample. It was not possible to predict employment in agencies of given size or in other research sub-samples through an analysis of this information.

Inter-judge reliability of TAT scores was high, and stable at the .01 level for story-by-story scores and for scores sorted by scoring categories. Reliability was less uniform and stable when average scores were used for general estimates of reliability. Ratings of predicted executive behavior which required the judges to make extensive extrapolations from the data were still less reliable and stable.

#### Inter-judge Reliability of TAT Scores

1. R for story-by-story scores ranged from .75\*\* to .86\*\*. Median R = .79\*\*.
2. R for category-by-category scores ranged from .37\*\* to .86\*\*. Median R = .79\*\*.
3. R for average scores sorted by job codes ranged from .13 (not significant) to .89\*\*. Median R = .82\*\*.
4. R for average scores sorted by scoring categories ranged from .03 (not significant) to .80\*\*. Median R = .47\*\*.

#### Inter-judge Reliability of Ratings of Predicted Executive Behavior

1. R for ratings sorted by job codes ranged from .37\*\* to .76\*\*. Median R = .57\*\*.
2. R for ratings sorted by predicted characteristic of behavior ranged from .01 (not significant) to .71\*\*. Median R = .44\*\*.

Microfilm \$3.95; Xerox \$13.75. 305 pages.

**TEST PERFORMANCE OF PSYCHOTIC CHILDREN  
WITH ORGANIC BRAIN PATHOLOGY:**

**A STUDY TO DETERMINE WHETHER THE  
BENDER-GESTALT TEST, THE BENTON VISUAL  
RETENTION TEST, AND THE MARBLE BOARD  
TEST CAN DETECT THE PRESENCE OF ORGANIC  
BRAIN PATHOLOGY IN PSYCHOTIC CHILDREN.**

(L. C. Card No. Mic 60-3755)

Marian Isabel Matunas, Ph.D.  
New York University, 1960

Chairman: Professor Edward L. Kemp

This study investigated the usefulness of selected tests in the detection of organic brain pathology in psychotic children. Previous studies have been concerned with the diagnosis of organic brain pathology in brain-damaged non-psychotic subjects, and also in the performance of psychotics on tests designed to indicate the presence of organic brain pathology. However, no research was found which indicated whether or not it is possible to detect organic brain pathology in children who were also psychotic by the use of tests primarily designed for the detection of brain pathology. The three instruments selected were the Bender-Gestalt Test, the Benton Visual Retention Test, and the Marble Board Test.

The four sub-problems of this study were to investigate the ability of each of the three tests to detect the presence of organic brain pathology in psychotic children, and also to determine which, if any, of the tests was the most effective diagnostic tool.

The subjects were males, between the ages of ten to fifteen, who were patients at either Creedmoor State Hospital, Queens Village, New York, or Kings Park State Hospital, Kings Park, New York. The experimental group was composed of psychotic children with organic brain pathology, and the control group was composed of psychotic children without organic brain pathology. The groups were matched by age and intelligence, and there were seventeen subjects in each group.

The statistical measure which was used to compare the two groups of subjects on the Bender-Gestalt Test and the Benton Visual Retention Test was the standard error of the difference between means for paired observations. The Marble Board Test had two scoring systems, one for the accuracy of the completed design, and the other for the method the subject used in completing the design. Since brain-injured subjects have been found to use an "incoherent" method to solve the task, the two groups were compared by the number of "incoherent" approaches made by the subjects. The Wilcoxon matched-pairs signed-ranks test was used to compare the experimental and control groups on both the Accuracy and Method scores. Significance was accepted, throughout, at the five per cent level.

The results of this study indicated that the Bender-Gestalt Test, the Benton Visual Retention Test, and the Accuracy score of the Marble Board Test were not able to detect the presence of organic brain pathology in psychotic children since there were no significant differences between the scores of the experimental and control groups. However, it was found that on the Method score of the Marble Board Test the experimental group made significantly more "incoherent" approaches than the control

group, and therefore, this technique can be used for the detection of organic brain pathology in psychotic children.

The success of the Marble Board Test Method score appeared especially interesting since it employed a different kind of scoring than the three other measures. The Bender-Gestalt Test, the Benton Visual Retention Test and the Accuracy score of the Marble Board Test were concerned with the final result, the finished product. The Method score of the Marble Board Test, however, concentrated on the manner by which the subjects arrived at the completed pattern. The Method of execution of the task was what differentiated the two groups, not the final score.

Suggested areas for further research are:

1. The development of a normative scale for the Marble Board Test.
2. The effect of emotional illness upon the Benton Visual Retention Test scores of children.
3. The effect of brain lesions of different sizes and locations upon the Bender-Gestalt Test performances of children.

Microfilm \$2.50; Xerox \$4.20. 79 pages.

**AN EXPLORATORY STUDY  
OF SUICIDAL THINKING**

(L. C. Card No. Mic 60-4335)

Charles Neuringer, Ph.D.  
University of Kansas, 1960

The present study asked the broad question: Can cognitive level factors be of help in differentiating suicide-prone individuals from non-suicidal persons? Certain hypotheses concerning three cognitive factors were studied. They were (a) Rigidity, (b) Bi-Polar Shifting and (c) Dichotomous Thinking.

Three groups of subjects were used. They were (a) a group of hospitalized suicidal attempt subjects, (b) a group of hospitalized psychosomatic patients and (c) a group of hospitalized normal subjects. They were administered four tests of cognitive functioning. These were (1) the California F Scale, (2) The Map Reading Test, (3) the Imbalance Situations Test and (4) the Semantic Differential. It was predicted that the suicidal subjects would score highest on these four assessment measures since they purport to reflect and measure the three cognitive factors studied.

The results of the data analysis indicated the following:

1. There were no significant differences among the personal characteristics of the three groups of subjects, except for length of time spent in the hospital prior to participation in the study. However, this variable did not correlate highly with the assessment measures.
2. The suicidal group made significantly more rigid solutions on the Map Reading Test than the psychosomatic and normal groups.
3. The suicidal group earned significantly greater F Scale scores than the psychosomatic and normal groups.
4. The suicidal and psychosomatic groups earned significantly higher shift scores on the Imbalance Situations Test than the normal group.



5. The suicidal and psychosomatic groups earned significantly greater scores on the Semantic Differential.

The following conclusions were reached:

1. Rigidity, Bi-Polar Shifts and Dichotomous Thinking were found in all the subjects utilized in the present study. These cognitive modes seem to be characteristic of all peoples. Excessive utilization of them may be considered as signs of psychopathology.

2. Greater Rigidity of thinking was found for the suicidal group when compared with the normal group. The implication of this finding is that excessive Rigidity is a hallmark of suicidal thinking.

3. Bi-Polar Shifting and Dichotomous Thinking appear to be common characteristics of emotionally disturbed "neurotic" suicidal and psychosomatic individuals.

4. It was felt that the data of the present study supported the view that suicidal behavior is a symptom of personality disorganization and not due to the presence of a clear-cut suicidal personality syndrome.

Microfilm \$2.50; Xerox \$7.80. 168 pages.

**A STUDY OF CERTAIN CONSTRUCTS  
USED IN COMMUNICATION BY  
SCHOOL WORKERS AND OTHER PROFESSIONAL  
MENTAL HEALTH PERSONNEL**

(L. C. Card No. Mic 60-4131)

Joel Edward Shelton, Ph.D.  
The Ohio State University, 1960

The purpose of this study was to examine the range of convenience or generality of a group of descriptive terms of dimensions used by professional workers in the fields of mental health and education to describe children and clients with whom they work. It was hypothesized that differences in the range of convenience or generality of these terms would appear and that these differences would be barriers to good communication about children. These barriers in communication could lead to poor service to children and their families whenever service involved the different professional groups.

Samples of teachers, counselors, school psychologists, psychiatrists, clinical psychologists, and psychiatric social workers were drawn from thirty-two school systems and thirty-seven mental health agencies, distributed over the state of Ohio. These participants were asked to select a representative group of children or clients with whom they worked and to apply certain descriptive dimensions to this representative sample on an adaptation of Kelly's Role Construct Repertory Grid. This grid involved a set of thirty-five bi-polar constructs, derived from a preliminary study of responses to a minor revision of the Role Construct Repertory Test.

A group of sixteen null hypotheses were stated in terms of comparisons between the various single professions and between school personnel and mental health personnel. These hypotheses were tested from the data gathered on the experimental grid by use of Cattell's  $r_p$  Profile Correlation Coefficient, F-tests for significant variability, and t-tests among pairs of professions on those items with significant F-tests.

The main findings were as follows:

1. There were no significant differences in range of convenience for these constructs among the mental health professions.

2. Among the school professions, there was much significant variation.

3. Between clinic professions and school professions, pair by pair, there were marked significant differences.

The comparisons between pairs of professions and between the school and mental health professions, as groups, were shown graphically and in tabular form.

Microfilm \$2.50; Xerox \$7.00. 147 pages.

**CONCEPT OF FATHER AND IDEAL SELF  
IN A GROUP OF CRIMINALS  
AND NON-CRIMINALS**

(L. C. Card No. Mic 60-3760)

Franklyn Bruce Springfield, Ph.D.  
New York University, 1960

Chairman: Professor Dan W. Dodson

The purpose of the study was to determine whether adult male criminals who had committed a crime against a person showed a greater or lesser degree of congruence between their concept of their ideal self and their concept of their father than did adult male non-criminals. To do this three tests were administered: The Study of Values, The Thurstone Interest Schedule, and The F Scale. In the first test administration the subjects were directed to answer as if they were perfect, as they thought their ideal person might answer. In the second test administration the subjects were directed to answer as they thought their fathers might answer. The discrepancy between the scores of the corresponding tests in the two test administrations was used to determine the degree of congruence between concept of father and ideal.

In addition to the above noted instruments, the Bernreuter Personality Inventory was administered once, its purpose being to understand the individual subject better rather than to provide a contrast between father and ideal. To further this end, case history information about each subject was gathered concerning his relationships with his father, his environment, and other people.

Meaningful inter-group and intra-group differences were identified by means of  $t$  tests of significance.

Results indicated that the criminal group tended to show less of a degree of congruence between their concept of their ideal self and their concept of their father than did the non-criminal group, in most, but not all, of the areas explored. The criminal tended to see his ideal as significantly more interested than his father in the areas of aesthetics, humanitarianism, art, music, and linguistic skills. He saw his father as significantly more interested than his ideal in the areas of theoretical skills, economic and political interests, and computational abilities. The criminal's father was also thought of as a much more authoritarian person than was his ideal.

The non-criminal tended to see his ideal as significantly more interested in social relationships, physical sciences, and political and artistic interests than he did

his father. The non-criminal did not see his father as being significantly more interested in any area than his ideal, or differing significantly in terms of degree of authoritarianism.

The criminal was significantly more neurotic, more self sufficient, more extroverted, more dominant, and less self confident than the non-criminal. Also, by inspection, it appeared that the criminal group had received less affection and more severe discipline from their fathers than had the non-criminal group.

It was suggested that further research designed to evaluate the conscious and unconscious ideals of the adult male criminal would be of value.

Microfilm \$2.50; Xerox \$6.20. 129 pages.

## PSYCHOLOGY, EXPERIMENTAL

### COGNITIVE FACTORS IN HEART RATE CONDITIONING

(L. C. Card No. Mic 60-3889)

Bishwa Bandhu Chatterjee, Ph.D.  
University of Illinois, 1960

Subjects chain associated to the visual presentation of 12 words in three colors (green, yellow, and red, four words in each color) repeated in 7 trial blocks, each containing the 12 words in random order. The duration of the CS was 0.5 sec.; a light flashed for 1 sec. after 8.5 sec. from the termination of the CS presentation, which was the sign for the S to stop free association. The US, a painful electric shock, coincided in time and duration with the stop signal.

Seventy-six freshmen and sophomore students of Introductory Psychology and Education (19 female and 57 male) constituted the three basic experimental groups. Group I Ss (N=9) were informed that presentation of one particular word, but of no other words, would always be followed by a shock. Group II Ss (N=11) were informed that one particular word always be followed by shock, and each of the remaining words would be followed by shock once. Group III Ss were only told that they should expect a certain number of shocks. All groups were told that there would be no shock during the last trial blocks. In all groups, the word boat was always followed by shock; in Groups II and III the remaining words were each shocked once.

In the extinction trials, run in continuation with the acquisition trials, the word boat, and 11 new words were used, 5 of which were semantically similar to boat. Extinction words were also presented in three colors, green, yellow, and red.

After the end of the extinction trials, Ss were questioned intensively to obtain verbal reports of what they thought was the frequency of shock associated with each stimulus word. Electrotachogram of each S was recorded during the duration of the experiment.

Using the reported frequency of shock following each word, the Group III Ss were divided into two groups: Group III-A (N=29), in which Ss had shown more or less correct recognition of boat as the word associated with

most shocks, and Group III-U (N=27), in which the Ss did not show such level of verbal discrimination.

The "cardiac response difference" obtained by algebraically subtracting the minimum cardiac latency within 4 beats following the presentation of a CS from the same within 4 beats before the presentation of the CS, was the measure used for testing conditioning and generalization in different groups.

The absolute magnitude of the cardiac response difference for all trials was found to be significantly less in Group I than in the remaining groups. Analysis of the percentage of Ss in any group giving highest positive response difference to boat, and of the mean ranks of the response difference to boat, on different trial blocks, provided evidence of conditioning in Groups I and II, but not in Groups III-A and III-U. The absence of stimulus generalization in all groups, and the difference between the experimental groups in the extent of conditioning and magnitude of response differences, were found to be significantly related to the systematic variation of cognitive expectancy of shock in the different groups. The hypothesis that correct cognitive discrimination of the word-shock contingency emerged in Group III-A during the last acquisition trials was supported by an analysis restricted to the response differences on the last conditioning trial block.

Microfilm \$2.50; Xerox \$4.40. 82 pages.

### INCONSISTENCY OF EARLY HANDLING AND ITS EFFECT UPON EMOTIONALITY IN THE RAT

(L. C. Card No. Mic 60-4748)

Janet Frances Eells, Ph.D.  
Northwestern University, 1960

Adviser: Janet A. Taylor

For the purpose of studying the effects of inconsistency of early treatment upon later emotional adjustment, four groups of 10 male albino rats each were subjected to various kinds of handling during childhood. From the 14th to the 62nd day of life, one group was handled gently for five 2 min. periods daily. The second group was mistreated for equal periods of time, while the third group was both petted and mistreated in random order. A control group received no handling during this period.

All animals were tested from the 62nd to the 78th day in a variety of situations designed to measure some aspects of emotional response to the environment. Tests included ratings of general activity level, ratings of emotional response to handling, extent of S's attempt to leave the home cage when given an opportunity, willingness to venture out upon a narrow runway in search of food, tendency to seek the seclusion of a small, dark box in preference to exploration of an open, lighted area, and change in water consumption following electric shock.

Analyses of results yielded a consistent pattern of differences on all tests except that of water consumption, with most differences significant at acceptable levels of confidence. The Ss which had been unhandled since birth exhibited signs of greatest emotional reactivity, while Ss which had been consistently petted appeared to have the



highest threshold for emotional response. The two other groups, consistently mistreated, and inconsistently petted and mistreated, fell near the middle of the range of emotionality with the inconsistent group somewhat less emotional than the consistently mistreated Ss.

Differences among groups on the Water Consumption Test, the only test involving a severe stress situation, failed to reach significance at an acceptable level of confidence.

It was concluded that the kind of handling given a rat during early life does influence later emotionality, but no evidence was found to support the hypothesis that inconsistently treated Ss are more emotional than consistently mistreated ones. The observed differences were discussed in terms of the apparent nonmonotonic change in emotionality as a function of increasing intensity of stimulation up to and beyond a certain optimum point, and the possibility that all results may have been based on some aspect of differences in activity level rather than emotionality per se. Microfilm \$2.50; Xerox \$5.60. 115 pages.

**TACHISTOSCOPIC IDENTIFICATION  
OF WORDS AS A FUNCTION OF  
CATEGORY SET, SELECTIVE VERBAL REPORT,  
MODE OF PSYCHOLOGICAL DEFENSE,  
AND GENERALIZATION OF THREAT.**

(L. C. Card No. Mic 60-4326)

Ronald Hamby, Ph.D.  
University of Kansas, 1960

1. Statement of the Problem. This research was designed to answer the general question: Is there evidence of perceptual defense (repression) and perceptual vigilance in perception of words after a number of methodological factors have been taken into account? Specific questions investigated were the effects on word-identification thresholds (a) of categorical size restriction, (b) of two modes of psychological defense (Repression and Vigilance), (c) of the interaction of mode of defense with instructions designed to manipulate Ss' readiness to report identification of taboo words, and (d) of generalization of defense and/or anxiety, while controlling for word frequency (familiarity).

2. Method. Three categories of six words each--Weather, General Neutral, and Taboo--were presented tachistoscopically for 16 trials in four different orders. Exposure time was .01 second for the first series, increased .002 seconds for each succeeding series. From a population of 576 college males who had taken the MMPI, Repressors were selected from high scorers on the Hy-Pt Index; Vigilant Ss were low scorers (not using the K correction factor). Ss of both groups were assigned to one of three Instructions conditions--the Uninformed, the Informed, and the Facilitated (informed and ego-involved). The 3 categories were matched for frequency (familiarity).

3. Major Findings and Conclusions. The hypothesis that category size is a correlate of identification thresholds was only partially supported. The groups differed significantly in their reactions to the Weather words. The Vigilant group had significantly lower thresholds for Weather than for General Neutral words. The Repressors showed an opposite effect, significant at the .10 level, apparently due to the presence of Taboo words.

For Taboo words, both groups combined showed lower thresholds under the Informed condition than under the Uninformed condition, but there was no difference between the Informed and Facilitated conditions. For Weather words, both groups combined showed a reduction in thresholds for the Informed condition, relative to the Uninformed condition; but, a reversal of this effect was found under the Facilitated condition, apparently due to the reaction of the Repressor group to the Weather words.

The over-all analysis showed that the two defensive groups differed significantly only in their identification thresholds to Weather words. The groups did not differ in over-all accuracy of their perception, in their thresholds to Taboo words, or in reaction to the Instructions conditions, all words combined.

For the Repressor group, the defensive process while being refractory to one type of manipulation (Facilitated condition) was amenable to another type (Informed). Apparently, the meaning of the Taboo words to these Ss is variably affected by situation or context.

For the Vigilant group, instructions resulted in significant, almost linear, reductions in thresholds to Taboo words. But Taboo word thresholds were still significantly higher than Weather word thresholds, all conditions combined. For this group, no facilitation for Weather words occurred, suggesting interference by the Taboo set.

The groups did not differ in evidence of generalization. The Vigilant group, but not the Repressor group, considered separately, showed significantly more errors to words two or more steps removed from Taboo words than they showed to words one step removed. Expectancy and/or anxiety apparently interfered with identification of neutral words two or more places removed from Taboo words. Further research is needed to determine reliability of this finding.

Results may have been influenced by inadequacies: (a) in the criterion measure, (b) in the method of S selection, and/or (c) in the formulation of how the defensive modes operate. A reformulation of how Vigilance operates was offered. Microfilm \$2.50; Xerox \$5.20. 102 pages.

**SERIAL LEARNING AND RETENTION  
WITH REGULATED AND SELF-PACED  
METHODS OF ACQUISITION**

(L. C. Card No. Mic 60-4177)

Richard Joseph Hornick, Ph.D.  
Purdue University, 1960

Major Professor: L. M. Baker

This study employed two methods of acquiring serial material. One method was the traditional one in which presentation time of items was kept constant (regulated presentation). The second method was one in which Ss were free to spend as much or as little time as they liked at each serial position (self-paced acquisition). Three kinds of learning material were used---nonsense syllables, three-digit numbers, and three-letter words. The basic design, then, was a 2X3 factorial in which 10 Ss were used in each cell of the experiment.

It was found that regulated presentation produced bow-shaped curves for each of the learning materials.

Self-paced acquisition resulted in flatter serial curves for syllables and numbers, but the curves were still significantly bow-shaped. Only for words did self-paced acquisition result in a flat line with no significant bowing.

The time *Ss* spent anticipating each item was recorded when working in the self-paced method. It was shown that most anticipation time was taken for the centermost items, with least time at either end of the list.

Two aspects of learning efficiency were measured. They were the number of trials required and the total amount of time required to reach the learning criterion. For each of the materials the self-paced method was shown to be more efficient in terms of the number of trials. Also shown was that the self-paced method required significantly less total time for learning to take place. Both measures, therefore, demonstrated that self-pacing was a more efficient method of acquisition than a regulated presentation of items.

Retention measures were employed 48 hours after the original learning. Both methods of learning and all materials resulted in nearly perfect retention with no differences between treatment combinations. The retained items were identified with regard to the serial positions in which they were learned. It was found that the serial retention curves were essentially flat 48 hours after learning for both methods and all materials.

Microfilm \$2.50; Xerox \$4.00. 75 pages.

#### RESPONSE CHAINING PARADIGMS FOR TRANSFER IN PAIRED ASSOCIATE LEARNING

(L. C. Card No. Mic 60-3554)

David Lee Horton, Ph.D.  
University of Minnesota, 1959

Adviser: James J. Jenkins

This investigation has dealt with the role of mediate association in the verbal transfer process. Although the systematic formulation of this concept goes back to Hull's early papers, the research dealing with it has been quite limited in scope and relatively unsystematic. This has been especially true of the "chaining" models which were the concern of this study. The previous work on such models has been done largely with verbal materials in the context of paired-associate learning. These studies have suggested several factors, such as reverse association, which may be important in the transfer process. In addition, these factors lead to the consideration of mediate association models where the mediation takes place during the learning stages as well as the traditional final stage. The present experiment constituted an attempt to discover which of the four possible chaining paradigms would show positive transfer and which factors might account for such transfer as well as differences between paradigms in the degree of transfer.

The materials used were real words taken from the Thorndike and Lorge lists (1944). An attempt was made to control the familiarity of these words by taking rare words and only those rare words having the lowest associative value for individuals similar to the *S's* of this

experiment. Several controls were introduced in an attempt to remove effects due to particular words or word pairs. This necessitated twelve different lists which were assigned to the paradigms in a counterbalanced order. The actual arrangement was made across eight paradigms since this study was carried out as part of a larger one including the stimulus and response equivalence models. The *S's* were then assigned to the paradigms at random. Since three of the four paradigms have rarely been studied it appeared more important to establish the presence or absence of generalization with each of them than to establish differences between paradigms. In view of this a split-unit design was used since this technique maximizes sensitivity on the within paradigm transfer effect.

The results of this investigation clearly establish the transfer effect with three of the four paradigms. The remaining paradigm shows positive generalization although it is not significant. None of the "between-paradigm" differences is significant but three of the four comparisons made were in the predicted direction.

These results confirm the importance of both forward and reverse mediate associations in the verbal transfer process. Furthermore, there is sufficient evidence for remote forward association and implicit occurrence of previously learned associations to warrant further research on these factors. In an attempt to discover reasons for *S's* failing to generalize with paradigms showing highly significant generalization the *S's* were questioned about their attitudes and methods. The answers given suggest that task set (e.g., what is supposed to be done?) and strategy (e.g., how is it supposed to be done?) may be important in obtaining transfer. In any case, further investigation of these variables seems necessary.

In conclusion, this study has clearly established the transfer effect with the chaining models and has strongly supported the importance of several associative factors while suggesting the need for investigation of others. In addition, individual difference factors, such as task set and strategy, are suggested as important parameters in generalization and warrant further investigation.

Microfilm \$2.50; Xerox \$3.80. 69 pages.

#### RUNWAY PERFORMANCE AS A FUNCTION OF DRIVE STRENGTH AND MAGNITUDE OF REINFORCEMENT

(L. C. Card No. Mic 60-4331)

Walter Kintsch, Ph.D.  
University of Kansas, 1960

The present study was concerned with the influence of magnitude of reinforcement and drive strength upon runway performance.

1. Method: The experiment consisted of two replications of a 3 x 3 factorial design with three magnitudes of reinforcement and three values of drive strength. For the first replication 22 hooded rats were used, and for the second 18 albinos.

The apparatus was a 7-ft. straight alley runway. Response latencies and running times were measured automatically with electric timers operated by photo-cells. A record was also kept of the competing responses which occurred in the runway.



All Ss were on a 23 hr. water deprivation schedule. During training Ss of the low drive group received 6 cc. of water 5 min. before the runway trial, the medium drive Ss received 3 cc., and the high drive Ss were not pre-watered. Low reward Ss were allowed to drink 0.25 cc. of water in the goal box, medium reward Ss had 1.75 cc., and high reward Ss received 3.25 cc. of water. Training was continued for 55 days with 1 trial per day. Following acquisition 8 extinction trials were given, also 1 per day. Drive conditions were unchanged during extinction, and no water was available in the goal box.

2. **Results:** An analysis of variance of the asymptotic starting speeds (trials 41-55) during training showed that the effects of drive and reward, as well as the drive x reward interaction were statistically significant at the .01 level. Greater drive strengths and greater amounts of reward led to higher starting speeds. The differences between the values of one factor depended upon the level of the other. Great differences were obtained between the drive conditions when a large reward was given. These differences were smaller when a medium reward was given, and nearly disappeared when only a small reward was given. The differences between the reward conditions depended similarly upon the level of drive strength.

The effects of drive and reward upon running speeds were the same as upon starting speeds. Both main effects and their interaction were significant statistically.

The number of competing responses tended to decrease with higher drive strength and higher amount of reward, but only the latter effect was significant. Very few competing responses occurred after the first two weeks of training.

No significant differences between the experimental conditions were obtained during extinction.

3. **Discussion:** The finding of a significant interaction effect in both the starting speed and running speed analyses appeared to be contradictory to Spence's hypothesis that drive and reward combine additively. Hull's assumption of a multiplicative relationship between drive and reward, on the other hand, was supported by the data. This latter conclusion was based upon the following evidence:

1. A significant drive x reward interaction was obtained. This, however, did not specify the nature of the interaction.
2. The differences in speed between the three drive conditions depended upon the level of reward, i.e., the larger the reward, the greater the differences between the drive conditions. In the same way speed differences produced by different amounts of reward were enlarged with high drive and diminished under low drive. These observations suggested a multiplicative interaction between drive and reward.
3. If an interaction is known to be multiplicative, it was shown that a logarithmic transformation of the scale of measurement produces additivity. Since no significant interaction effect in an analysis of variance of the log speed scores was obtained it was concluded that the interaction was probably multiplicative.

At the beginning of training the differences in running speeds between the nine experimental groups were partly due to the influence of competing behavior. However, large differences were obtained after prolonged training when almost no competing responses occurred.

Microfilm \$2.50; Xerox \$7.60. 161 pages.

## THE DEVELOPMENT OF A FORM CONSTANCY AS A FUNCTION OF REWARD

(L. C. Card No. Mic 60-4333)

Harold Joseph McNamara, Ph.D.  
University of Kansas, 1960

It was proposed that perception, in contrast to views that propose discrete dimensions or classes of perceptual phenomena, could be conceptualized as a "perceptual act." This latter view proposes that perception has response-like properties and within limits, behaves as any other response. The perceptual act, according to Solley and Murphy, can be defined in terms of its temporal stages, i.e., perceptual expectancy, attending, reception, trial and check, and finally perceptual organization. The series of studies presented here attempted to show how the first stages of the perceptual act were dependent upon past experience and how these first stages influenced the reception stage of the act. The specific proposal was that attention as an "attentional act" had to do with the selection and/or exclusion of cues and as such, was partially responsible for determining the proximal stimulus, i.e., the first part of reception.

In order to test the above propositions, three experiments were carried out. Experiment I was designed to evaluate the propositions that "form" is not constant under spatial transformation. Experiment II proposed that through reinforcement the response to the transformed form would become more constant. Experiment III was designed to test the proposition that the crucial variable was attention and that it was changes in the Ss' attentional responses which resulted in more constant perceptions of the stimulus. It was proposed that increased attention would result in a more accurate performance in a depth perception task. It was proposed that if the effects of learning resulted in increased attention to the form, the act of dealing with the form in a depth perception task would result in greater accuracy as a function of value.

The results in general supported the hypotheses that:

- 1) The constancy of a nonsense form under rotation would be related to the magnitude of the reward and the conditions of learning.
- 2) The increased constancy was partially a function of an increased attention to the form, and this increased attention was a function of conditions, built up in the organism, existent prior to stimulation.

It was proposed that the function of learning in perception can be most adequately assessed if perception is conceptualized as an "act." It was specifically proposed that the "attentional act" was responsible for the selection and exclusion of cues as a result of the modification of the response-like properties of the "act."

The concept of the "perceptual act" was also discussed in terms of emitted and elicited perceptual acts. It was speculated that in many cases there is a close relationship between a given stimulus complex and a specific perceptual response. This close relationship was thought to produce an elicited perceptual act in much the same way as a specific unconditioned stimulus leads to its concomitant response.

Microfilm \$2.50; Xerox \$4.80. 92 pages.



# A CROSS-LINGUISTIC INVESTIGATION OF PHONETIC SYMBOLISM

(L. C. Card No. Mic 60-3961)

Murray Samuel Miron, Ph.D.  
University of Illinois, 1960

An experiment is reported in which a set of 50 nonsense stimulus items of CVC shape were judged on a set of 16 semantic differential scales by two groups of subjects with contrasting linguistic background. The languages used were Japanese and English. Experimental stimulus controls took the form of an incomplete Latin square design in which each of the consonant elements preceded and followed each of the vowel elements an equal number of times with all elements represented and equally frequent in the final matrix. Five vowel and consonant elements, appearing in both languages, were chosen. Prior to analysis of the data three composite scales were formed by summing judgments made by all subjects within a given language group on a number of scales. These composite scales were identified as an evaluative composite, a potency composite and an activity composite. All analyses utilized these composite scales.

The analysis of the data was divided into six main content areas. (1) Scale and composite scale reliabilities. Reliabilities for the composite scales in the two experimental groups were found to be sufficiently high for the purpose of this research. (2) Composite scale means. The mean judgments for all subjects in both groups on the three composite scales indicated a general trend toward evaluating the front vowels and consonants as "pleasant" and "weak," and the back vowels and consonants as more "unpleasant" and "strong." Comparison of the composite scale means for the phoneme elements and the individual stimulus means across the two groups indicated significant agreement in judgments. (3) Analysis of variance. Four-way analyses of variance indicated that, in the main, the phoneme elements, the phoneme combinations and the unique stimulus items were reliably differentiated in the aggregate by the subjects of both groups. Consonant positions were found to differ reliably in terms of subject judgments, as were the specific consonant-vowel combinations employed. (4) Familiarity judgments and meaningfulness. Data collected on the familiarity of the stimulus items indicated that over-all the items were judged to be relatively unfamiliar and that "real" word responses were minimal in all instances save one. Significant internal variations of the list were found in terms of familiarity; familiarity was shown to co-vary with evaluative scores, but not with judgments of potency and activity. (5) Scale intercorrelations and factor analyses. Intercorrelations of the scales within each language group indicated a high degree of clustering for each of the scales contributing to a given composite scale; such clusterings were found to be similar for both groups. A centroid factor analysis of the scale intercorrelations revealed the presence of three factors which accounted for a high percentage of the total variance in mean judgments for both groups. These factors were easily identifiable as corresponding to previous dimensions revealed in previous analyses of meaningful material. (6) Factor structure comparisons. The two language groups were found to have a high degree of similarity with respect to the factor loading profiles on each of the dimensions isolated.

It was concluded that the materials, representing nonsense combinations composed of systematically sampled speech sounds, had expressive symbolic values accruing to their inherent phonetic content and not to any meanings via real-word associates. These affective meanings were found to bear consistent, lawful relations to the phonetic properties of the sounds. The fact that these meaningful differentiations and their relations to phonetic properties prove to be highly similar across two contrasting linguistic groups, suggests that the laws governing phonetic symbolism may have a universal character. Microfilm \$2.50; Xerox \$5.00. 97 pages.

# RUNNING MEMORY AND PREDICTION AS A FUNCTION OF SEQUENTIAL CONTEXT

(L. C. Card No. Mic 60-4245)

Mary Elizabeth Moore, Ph.D.  
Rutgers University, 1960

Major Professor: Dr. Bruce M. Ross

The present study differed from previous studies of human prediction of probabilistic events in two respects. First, since the emphasis was on the effect of specific event-sequences rather than on the development of asymptotic levels of performance, the sequence of events presented to S was short, containing only 42 items. Second, since it was felt that to a large extent, S's predictions are a function of what he remembers about the sequence up to that point, a running memory task was included with the prediction task so that the relationship between memory and prediction as well as the memory task *per se* could be investigated.

The prediction task employed was different from the usual one in which S is asked to predict what the next in a series of events will be. Instead of this a more complicated task was employed in which S was required to predict in the presence of each event whether the event occurring next would be the "same" or "different" from the one which had occurred just previously. The prediction was thus made in terms of once-removed comparisons between events. The memory task was comparable. The S had always to remember whether the event taking place was the "same" or "different" from the one before the previous one. The events consisted of symbols (crosses, circles, lines, and squares) projected on a screen. The symbols were changed as soon as S had given his memory and prediction response.

Sixteen Ss in each of seven different experimental conditions were run. These conditions differed by virtue of the tasks required of S (memory only, prediction followed by memory, and memory followed by prediction) and the type of symbol-sequences with which he was presented. There were five random symbol-sequences. The three binary sequences were: (1) a 50-50 symbol distribution in which 50% of the once-removed comparisons were "same," (2) a 67-33 symbol distribution in which 67% of the comparisons were "same," and (3) a 75-25 symbol distribution in which 75% of the comparisons were "same." Two were multi-symbol sequences: (1) a 33-33-33 symbol distribution in which 67% of the once-removed



comparisons were "different," and (2) a 25-25-25-25 symbol distribution in which 75% of the comparisons were "different."

Among the more important findings were the following:

(1) *S*'s total predictions tended more in the direction of "event matching" in the multi-symbol series than in the two-symbol series. *S*'s *a priori* assumptions were favored over probability learning explanations.

(2) Post-test questioning revealed that *S* had learned a great deal about the nature of the sequences which was not revealed when his predictive behavior alone was taken into account.

(3) Total memory errors were less when the symbol and comparison proportions were extreme and, most interestingly, where the multi-symbol, as opposed to the two-symbol conditions were involved. Apparently, the seemingly more complex multi-symbol conditions were psychologically simpler because they coincided with certain of *S*'s expectations.

(4) When predictions were analyzed according to symbol runs, the well-known "maturity of the chances" or "negative recency" effect was found. Differences in the shape of the run curves coincided with differences in the event-sequences.

(5) Memory errors were related to the type of immediately preceding three-symbol sequence. A consistent effect dependent upon whether the third symbol back was part of a subsequently developing run was noted. A coding process was postulated to account for these results.

Microfilm \$2.50; Xerox \$3.00. 53 pages.

#### INDIVIDUAL DIFFERENCES IN REACTION TO MEPROBAMATE: A STUDY IN VISUAL PERCEPTION.

(L. C. Card No. Mic 60-4257)

Katherine Ford Ruttiger, Ph.D.  
Rutgers University, 1960

Major Professor: Dr. Morgan Upton

A study was made of a number of visual reactions generally believed to be indicative of individual differences in nervous system functioning; of the effect of meprobamate (Miltown) upon them; and of the possible relationship of these reactions to personality ratings. The tests used were the Necker Cube (reversible figure), Retinal Rivalry (red-green oscillation), the Archimedes Spiral (after-effect of seen movement), the Peripheral Span (speed of perception), and the Maudsley Personality Inventory (Eysenck). Two groups of 34 college-age males each, assigned to drug and placebo conditions by the double-blind method, were given pretests, followed on the same day (some five hours later) by identical tests begun exactly one and one-half hours after ingesting 1600 mg. of meprobamate or a placebo of identical appearance.

The only test upon which the drug produced a demonstrable effect was the Retinal Rivalry where the reversal rate for red-green, instead of increasing with experience

as expected, became definitely slower in the drug group (probability of the interaction effect being less than .05). The Cube reversals correlated positively with Retinal Rivalry. The drug, however, showed no effect upon the Cube reversals, nor upon the Spiral whose after-effect has been demonstrated to be a cortical phenomenon. In view of the known effect of meprobamate upon the thalamus including the visual nuclei, the question is raised whether the action of the drug on the geniculate bodies may be associated with the decrease in color reversals.

The decrease in Spiral after-effect over trials, appearing identically in both drug and placebo groups, was seen to be a function of those subjects whose initial reaction was long; short reactors ended nearly where they began. Experience with the Spiral dissipated the initially long after-effect which did not return even after five hours. These long reactors tended to be higher on the Eysenck neuroticism scale than the low reactors. No other datum of interest appeared relative to the personality scales either on the tests after medication or on the pretests where the visual task itself could be assessed with the two random groups.

The Span Test showed no mean change in speed of perception of black Roman letters projected individually upon a white screen for one-fifth second duration at various radial distances up to eight inches from a center fixation point. Nor was any quadrant of vision affected by the drug, though the quadrants varied among themselves in visual efficiency, the upper left leading in superiority followed by the lower right, then the upper right, with the lower left being definitely the inferior of all.

Among the perception tests only the Necker Cube and the Retinal Rivalry seemed to be related. Though the inter-individual ranges of scores on all tests were great, the intra-individual performances were high consistent. Scores on Neuroticism and Extraversion-Introversion covered the entire possible range, yet provided little clue to these consistent individual differences. Such a question as why the majority of subjects lost in score on red-green rivalry under Meprobamate while some few others actually gained under the same dosage will likely never be explained by a verbal questionnaire.

Microfilm \$2.50; Xerox \$5.60. 111 pages.

#### THE EFFECTS OF REWARD SCHEDULES AND DRIVE CONDITIONS ON SECONDARY REINFORCEMENT

(L. C. Card No. Mic 60-4337)

Earl Donald Scott, Ph.D.  
University of Kansas, 1960

The experiment was performed to assess the effect of multiple drive training and intermittent reinforcement schedules, and combinations of these variables, on the strength of a secondary reinforcer by using a 2 X 2 X 2 X 2 factorial design. The experimental variables were: (1) number of training drives, one vs. two; (2) primary reinforcement schedule during training, continuous vs. partial; (3) test drive, hunger vs. thirst; and (4) *S*<sup>r</sup> schedule during test, continuous vs. partial.

Forty-eight rats were used as subjects in a modified

Skinner Box apparatus. The experiment was performed in three phases: the first phase consisted of determining the operant level of a bar pressing response; the second phase was a  $S^T$  training period, and in the third phase  $Ss$  were again tested for the bar pressing response.

In order to evaluate the posttraining performance the  $Ss$  were subjected to an operant level test of 10 minutes duration on each of four consecutive days prior to the beginning of  $S^T$  training. During the operant level test the bar, which was not available during the training period, was present and each depression of it was followed by the onset of the light which was to become the  $S^T$ .

The  $Ss$  were trained to approach the reinforcement delivery mechanism. During training, primary reinforcement was preceded by a light ( $S^T$ ). For half of the  $Ss$  the light was associated with the receipt of food, and for the other half it was associated with the receipt of food and water on alternate days. These conditions permitted a test of the generalized conditioned reinforcer hypothesis. Also during training, half of the  $Ss$  received primary reinforcement following each onset of the  $S^T$ , while the other half received primary reinforcement with the  $S^T$  only on a restricted portion of the trials. The  $S^T$  training extended over a 10-day period.

In the posttraining test a bar was re-inserted into the apparatus. For half of the  $Ss$  each depression of the bar was followed by the  $S^T$ , and for the remaining half the  $S^T$  followed the bar depressions on a partial schedule according to which the ratio of  $S^T$  presentations to bar depressions progressively decreased. Half of the  $Ss$  were hungry and half were thirsty throughout the testing period. The posttraining test lasted for 10 minutes on each of four consecutive days, with the dependent variable being the number of bar presses made with no other reinforcement than the  $S^T$ . Thus, the measure of the strength of the secondary reinforcement was the learning of a new response.

Of the main effects, one vs. two training drives, continuous vs. partial primary reinforcement in training, hunger vs. thirst as a test drive, and continuous vs. partial  $S^T$  in test, only the  $S^T$  schedule in test proved significant. More responses were made by  $Ss$  which received partial  $S^T$  than by those which received continuous  $S^T$  presentations. The ineffectiveness of the first and second variables offered no support for generalized conditioned reinforcement, or for Zimmerman's (1959) assertion that double intermittent reinforcement is conducive to the establishment of an effective  $S^T$ .

Two interaction effects were significant. The interaction of primary reinforcement schedule in training with the secondary reinforcement schedule in test was significant at the 5% level of confidence. Those  $Ss$  trained with continuous primary reinforcement and tested with partial secondary reinforcement, Group C-p, made more responses in test than the  $Ss$  trained and tested with different combinations of these variables, i.e., Groups C-c, P-p, and P-c. The second interaction that was significant was that of number of training drives with primary reinforcement schedule and test drive. Group HC-h, which had been trained with one drive present, a continuous primary reinforcement schedule and had been tested while hungry, gave more responses in the test period than Groups HC-t, HTP-t, HP-t, and HP-h, but did not respond a significantly greater number of times than Groups HTP-h, HTC-h, and HTC-t.

The results were related to previous investigations, and a post-experimental hypothesis was advanced which suggested that the results might be considered a consequence of both frustration and partial reinforcement effects.

#### REFERENCE

Zimmerman, D. W. (1959) Sustained performance in rats based on secondary reinforcement. *J. comp. physiol. Psychol.*, 52, 353-358.

Microfilm \$2.50; Xerox \$3.80. 68 pages.

#### ELECTRICAL ACTIVITY OF RAT BRAIN AS A CORRELATE OF PRIMARY DRIVE

(L. C. Card No. Mic 60-4000)

William Glenn Steiner, Ph.D.  
University of Illinois, 1960

The present experiment was designed to investigate the general adequacy of the concept of "arousal" in relation to an internally operating, appetitive drive. The experiment followed a simple pre-post experimental stratagem of inducing an appetitive drive state (thirst) and then of reducing this state through satiation of the appetitive drive (access to water). Brain wave recordings were taken during these pre- and post conditions, a brain wave activity score was determined for each condition and the scores were compared for change in the state of appetitive drive. Variation was introduced into this pre-post model by, (1) varying the degree of drive and the degree of satiation, by (2) indexing drive, both classically (hours of deprivation) and artificially (NaCl stomach load) by (3) varying the brain recording site (cortical and subcortical) and, by (4) varying the brain wave frequency selected for recording. Brain placements were paired within each animal giving each animal a cortical and subcortical recording site. Brain placements were confirmed by histological examination. Subjects and experiments were replicated with every subject being run under every experimental condition. Brain wave activity scores were assigned according to three different criteria, (1) a frequency criterion, (2) a frequency-amplitude criterion, and (3) an amplitude criterion. Changes were assessed by means of the analysis of variance. The entire series of experiments involved 33 animals with two brain placements each, requiring 4,296 brain wave activity samples yielding 12,888 scores for analysis.

The results were in general agreement with the activation hypothesis. The proposition that neural activity is subject to the influence of internally operating, appetitive drive was fully supported. The proposition which assumed that level of central neural activity is a direct function of level of drive found only partial support. The higher levels of drive, produced by the various NaCl concentrations, were not found to be directly related to level of neural activity. This breakdown was assumed to be the result of extraneous, uncontrolled factors. The proposition concerning spectral shifts under activated and de-activated conditions found presumptive support. Synchronization appeared to be more generalized across the frequency



spectrum than Lindsley's formulation would predict. Methods of recording were compared in an attempt to resolve this difference. The complexity of the activation phenomenon was discussed and a hypothetical example was presented which led to no prediction in spite of the fact that it was fully in accord with the various assumptions of the activation hypothesis. It was concluded that neural measures of arousal will be of little value in gauging drive level until the characteristic frequency response of a particular neural area has been determined for a variety of conditions and that the "heart" of the activation construct lies in the interaction of neural areas. The strength and weaknesses of the three scoring criteria were discussed and the criteria were related to each other in terms of the concept of signal-noise ratio. An activation criterion was proposed which sets an activation threshold at the level of desynchronization produced by startle. Several research problems were suggested. The proposition that it is the autonomic consequences of drive and not drive itself which activates was recommended for further review. It was the final conclusion of the methodology section that the answers which came out of this experiment were not as important as the encouragement to continue with further efforts at quantification, particularly with the use of the band pass filter. For those interested in the problem of the neural mediation of drive, the experiment gave assurance that the various neural structures do respond to changes in the level of internally operating appetitive drive states. Microfilm \$2.50; Xerox \$5.00. 96 pages.

A COMPARISON OF THE EFFECTS OF  
INTROVERSION-EXTROVERSION AND  
ANXIETY ON CONDITIONING

(L. C. Card No. Mic 60-3616)

Harvey Arnold Sweetbaum, Ph.D.  
University of Pennsylvania, 1960

Supervisor: Seymour Feshbach, Ph.D.

The present study investigates the effect of Eysenck's introversion-extroversion theory and Spence and Taylor's concept of anxiety on the conditioning of the eye-blink response. The possibility was raised that these two factors may have been confounded in previous studies. This experiment separates the effects of introversion from the effects of anxiety by varying them independently of one another. In order to accomplish this, subjects were drawn from an essentially normal population and subjected to situations designed to produce conditions of high and low anxiety. These conditions were provided by randomly assigning patients into two groups. Group I, designated as the anxious group, were about to undergo major surgery within a forty-eight hour period. By contrast, Group II, designated as the non-anxious group, were patients who had made a successful recovery from surgery. The Guilford R Scale, which Eysenck found to be a good measure of introversion-extroversion, was used to divide these subjects into high introvert and high extrovert groups. Fifty-six patients were finally selected, making up four groups of anxious-introvert, anxious extrovert, non-anxious-introvert, and non-anxious extrovert. All subjects

were then conditioned in a standard type eye-blink procedure. Analysis of the data shows strong support for the hypothesis, derived from Spence and Taylor's argument, which asserts that total drive is, in part, a function of the level of internal anxiety. The data from the pre-surgery, or anxious groups and the post-surgery, or non-anxious group shows the former to be consistently superior in the amount of conditioning. No significant difference was found in the conditionability between the introvert and the extrovert groups under conditions of either high or low anxiety. Microfilm \$2.50; Xerox \$3.00. 29 pages.

STUDIES IN VISUAL AFTEREFFECTS

(L. C. Card No. Mic 60-3839)

Robert Francis Terwilliger, Ph.D.  
Stanford University, 1960

A distinction is made between two types of figural aftereffects. The first of these is a size distortion in which the contour of the test figure is displaced equally over its whole extent. The second is a slant distortion in which the test figure is displaced unequally over its extent, the typical case being a distortion of a vertical line to nonverticality.

A conflict exists in the literature over whether the direction of size distortions is determined by the retinal or the apparent size of the figures used. Sutherland claims that apparent size is the determiner as long as the retinal sizes of the inspection and test figures are equal. A study was done using 180 subjects and nine different test figures. The results showed that the direction of distortion was determined by the retinal size of the figures alone. When the retinal sizes of the inspection and test figures were equal, there was no distortion. The distance paradox was observed.

A second study using forty subjects indicated that the above obtained retinal size law was subject to interocular transfer as are most figural aftereffects. There were no differences in the proportion of subjects who reported figural aftereffects between the various combinations of eyes which were used for inspection and testing.

A third study using four subjects showed that after-images also showed interocular transfer. The after-images followed Emmert's law even though the afterimage was created in one eye and the measurements done with the other. There were no significant differences between the various eye combinations used for fixation and measurement. These results are opposed to a statement made by Köhler and Wallach who said that figural aftereffects could not be explained by a process of contrast with after-images since afterimages do not show interocular transfer and figural aftereffects do. The conclusion was reached that there may be an intimate connection between size distortion figural aftereffects and afterimages.

A fourth study attempted to demonstrate that slant distortion figural aftereffects were determined by the retinal slant of the figures rather than the apparent slant. Retinal slant was varied by presenting the figures on tilted surfaces. Significant figural aftereffects were obtained only when the inspection and test figures were in the frontal plane. Thus it was impossible to tell whether the

retinal or the apparent slant was determining the direction of distortion. It was hypothesized that perhaps figural aftereffects were eliminated when either the inspection or the test figures were presented out of the frontal plane.

A study using sixty subjects was designed to test the above hypothesis. It was found that size distortions could be obtained when either the inspection or the test figure or both were out of the frontal plane. No evidence was obtained about slant distortions. Several studies were suggested for discovering why the fourth study was a failure. Microfilm \$2.50; Xerox \$4.20. 77 pages.

#### AN EXAMINATION OF TWO ALTERNATIVE ACCOUNTS OF T-MAZE LEARNING

(L. C. Card No. Mic 60-3704)

Elizabeth Kimball van Laer, Ph.D.  
University of Pennsylvania, 1960

Supervisor: Dr. William A. Shaw

The present study tested the predictive adequacy of two theoretical accounts of T-maze learning, one involving fractional antedating goal responses, and the other the notion of expectancy as formalized by MacCorquodale and Meehl.

The learning task consisted of a visual discrimination problem where a right turn made in a vertically striped (VS) T-maze led to water and a left turn made in a horizontally striped (HS) T-maze led to food. The Ss were both hungry and thirsty during training. Following an analysis made by Hull, the choice-point stimuli in the VS maze become connected to fractional antedating drinking responses ( $r_{G_d}$ ). The proprioceptive stimuli ( $s_{G_d}$ ) resulting from  $r_{G_d}$  become connected to right-turning responses. In the same way, the choice-point stimuli in the HS maze become connected to fractional antedating eating responses ( $r_{G_e}$ ). The proprioceptive stimuli ( $s_{G_e}$ ) resulting from  $r_{G_e}$  become connected to left-turning responses. If the right goal box was black when water was present, a connection between  $S_{black}$  and  $r_{G_d}$  should have been made. Similarly, if the left goal box was white when food was present, a connection between  $S_{white}$  and  $r_{G_e}$  should have been made.

On test trials, S was placed in a maze that was either all white or all black. If  $S_{black}$  have been connected to  $r_{G_d}$ , the presence of these stimuli should lead to the elicitation of  $r_{G_d}$ . And since during training  $s_{G_d}$  have been connected to right-turning responses,  $S_{black}$  should elicit a right turn on test trials. In the same way,  $S_{white}$  should elicit a left turn on test trials.

Following an analysis made by MacCorquodale and Meehl, two distinct expectancies are formed. When the choice-point stimulation consists of VS, S comes to expect that a right turn leads to water in the presence of the stimuli of the right goal box. When the choice-point stimuli are HS, S comes to expect that a left turn leads to food in the presence of the stimuli of the left goal box.

The differential prediction of test-trial behavior made by the two theories is based in part on the circumstance that, on test trials, Ss were satiated for both food and water. According to Hull, any effective habit strength is sensitized into reaction potentiality by all primary drives active within an organism at a given time. Presumably, some drives other than hunger and thirst will be operative on test trials. In MacCorquodale and Meehl's terms the valences that formerly activated the expectancies are at zero strength since valence is a function of time since satiation. Consequently, the Ss should not manifest any turning preference.

A second factor leads to the prediction of no turning preference, i.e., of random choice, from expectancy theory. There is a radical change in choice-point stimulation on the test trials. Since the expectancies were based on HS or VS, differential expectancies can exist with respect to black or white only through generalization. A balanced design was used to control for this possibility. A second group of Ss found a white goal box in the VS maze and a black goal box in the HS maze.

The results of the test trials were in accord with an expectancy notion rather than an  $r_G$  analysis. If  $r_G$  did develop during the learning trials they did not mediate the predicted behavior. The results of the experiment cast some doubt on the  $r_G$  interpretation of double drive and latent learning experiments.

Microfilm \$2.50; Xerox \$3.00. 50 pages.

#### THE ASSOCIATION OF ABNORMALITIES IN AUDITORY ADAPTATION TO OTHER AUDITORY PHENOMENA

(L. C. Card No. Mic 60-4814)

Jack Allen Willeford, Ph.D.  
Northwestern University, 1960

The experimental literature presents contradictory evidence concerning the clinical manifestation of threshold relapse, loudness recruitment, and abnormal sensitivity to intensity change at threshold. The present investigation, therefore, was designed to study the relapse behavior of a variety of clinical cases and to observe the relationship of this behavior to loudness recruitment and differential sensitivity to intensity change at threshold.

Tests which measured each of the phenomena outlined above were given to fifty-six subjects selected to represent seven categories. The techniques chosen were the threshold tone decay test, either the alternate binaural or the monaural loudness balance test, and an automatic threshold tracing of the Békésy type. These tests were



administered, in the order just named, to seven groups of eight subjects each. One group represented normal hearing, while the remaining six groups consisted of cases with hearing losses due to the following conditions: otitis media, otosclerosis, otosclerosis with secondary nerve degeneration, acoustic trauma, endolymphatic hydrops, and presbycusis. The hearing loss cases were selected on the basis of otological diagnoses.

Principal results and conclusions were as follows:

1. Threshold relapse and loudness recruitment both appeared predominantly in subjects with sensorineural hearing impairments. Neither phenomenon was prevalent in responses from subjects with conductive impairments.

2. The presbycusis subjects exhibited a higher incidence and greater magnitudes of threshold relapse than any other group studied. This observation was true of those presbycusis who gave evidence of also having loudness recruitment, as well as of those in whom recruitment was absent. Since recruitment is classically recognized as a cochlear phenomenon, the relapse exhibited by those presbycusis who failed to demonstrate the presence of recruitment was interpreted by the author as being of neural origin. This interpretation is not inconsistent with what is known of the auditory lesions characterizing presbycusis. This finding also indicated that relapse and recruitment are not inseparably related entities.

3. Acoustic trauma subjects showed substantial evidence of loudness recruitment. Only a few of these cases demonstrated relapse, however, and it was minimal in each case. This result provided further testimony that recruitment and relapse were not inseparably related phenomena. It also showed that relapse was not an invariable feature of cochlear disorders.

4. Substantial relapse, as well as loudness recruitment, was demonstrated by the majority of subjects with hearing losses due to endolymphatic hydrops. However, there were instances in which only recruitment was exhibited. Thus, not all hydrops cases showed relapse. There was an indication that relapse appeared only in those subjects within the hydrops group whose pathology was most active. Moreover, this finding emphasizes again that relapse is not necessarily a concomitant of recruitment when the latter phenomenon is exhibited in subjects whose ears have end-organ damage, and suggests that in some states the cochlear mechanism may manifest relapse while in other states it does not.

5. Although a few instances of mild relapse in the 250-1000 cps range were observed in otosclerotic subjects, it was not felt to be a significant finding.

6. In the present investigation, the Békésy-type threshold tracing, employing a continuous fixed-frequency stimulus, simply provided an indication of differential sensitivity to intensity change at threshold. This method of exploration failed to demonstrate any parallelism between abnormally reduced excursion amplitudes and recruitment as gauged by the loudness balance tests. Nor did automatic audiometry demonstrate cases of abnormal adaptation, as evidenced by a progressive shift in threshold level as stimulation was continued, in any of the groups of subjects studied.

Results of this study suggest the need for continued research on the relapse phenomenon in an effort to clarify its current complexities regarding auditory malfunction.

Microfilm \$2.50; Xerox \$7.80. 170 pages.

## RELIGION

### A STUDY OF JOHN JEWEL AS APOLOGIST OF THE CHURCH OF ENGLAND

(L. C. Card No. Mic 60-598)

John Everitt Booty, Ph.D.  
Princeton University, 1959

Supervisor: Professor Horton Davies

John Jewel, bishop of Salisbury (1559-1571), was the Apologist of the Church of England in the first crucial decade of the reign of Elizabeth I. As such he defended the Elizabethan Settlement of Religion against both Roman Catholics and Puritans. This study seeks to show how Jewel acquired and executed his official task. An exile during the Marian reign, Jewel returned to England in 1559, became a leader of the Protestant party and preached his famed Challenge Sermon at Paul's Cross and at the Court. In this sermon Jewel demonstrated his abilities as an apologist for the reformed English Church. When Secretary Cecil decided that an official defence of the Settlement of Religion should be published, he chose Jewel to compose the *Apologia Ecclesiae Anglicanae*. Cecil also commissioned Jewel to write an epistle defending the English clergy against the accusation of variety, an epistle which is disclosed and recorded for the first time in this study. Those details which are accessible concerning Jewel's work at this stage are explored and an effort is made to demonstrate that Jewel began work against the Catholic accusation of variety amongst the English clergy but gradually extended his defence as events progressed in 1561-2.

This represents the chief historical section of the study. From here we move on to explore Jewel's activities and behaviour as an apologist. First it is shown that the controversy which arose out of the Challenge Sermon and the *Apologia* ranged far and wide, but centered upon the debate between Jewel and Thomas Harding, two men who had previously known each other and had cause to dislike and fear one another. Next it is determined that Jewel was not a Puritan, that he chose to serve a godly and religiously conservative monarch rather than risk losing all. Then an investigation of Jewel's methods is made by means of a consideration of a charge made by his enemies that he was an inveterate liar. As the charge is explored his methods are revealed chiefly from evidence obtained from his personal library now at Magdalen College, Oxford. All of this shows that Jewel was working under considerable tension and that being extremely sensitive he was reluctant to admit any error.

Indeed, it is here shown that the challenge, which was the supposed basis of the controversy, was not to be taken altogether seriously. Jewel was convinced that he was right and that no positive evidence could be brought against him. He was sure of himself not only because he believed that the doctors and councils of the primitive church supported him (he admitted that they could err) but because the Holy Spirit revealed the truth in the Scriptures to him

personally. Entering now upon the theological content of Jewel's controversial writings, a full study of his theological position is not attempted, but some effort is made to reveal his basic orientation. Besides his position as regards doctrinal authority, attention is focused upon the question of the real presence in the Eucharist and the problem of ecclesiastical polity.

Microfilm \$6.10; Xerox \$21.60. 478 pages.

### THE SOUTHERN BAPTIST FOREIGN MISSION ENTERPRISE IN WESTERN NIGERIA: AN ANALYSIS.

(L. C. Card No. Mic 60-3447)

Hans Wilhelm Florin, Ph.D.  
Boston University Graduate School, 1960

Major Professor: Nils Ehrenstrom

This dissertation attempts to determine the range and the intensity of the Western missionary impact on the African scene. The Southern Baptist mission field in Western Nigeria serves as an example in case.

The phenomenon of the missionary impact is of a two-fold nature: religious and cultural. The cultural impact of Christian missionaries on the African scene has been of interest for some time, especially to students of the social sciences. As such, it has repeatedly been mentioned in sociological studies concerning certain aspects of social and cultural change. However, rarely has the missionary-induced culture change been studied per se, and never has such change been studied in a context which does justice to Christian missionary motivation as a primary source of action. It is, therefore, the objective of this study to describe this impact both as to its theological cause and its cultural implications. For this purpose, a methodology has had to be designed which would do justice to both the theological concern for and the sociological interest in the culture-mediating activity of the missionary work.

The methodology can be broken down into the following two steps. First, the Southern Baptist mission enterprise is described in terms of the theological, philosophical, and cultural forces which contribute to the Southern Baptist mission outreach to the Western Nigerian scene. Against the background of this knowledge, the program of the Southern Baptist mission operations is observed in its interaction with Nigerian Baptist institutions. Secondly, any Nigerian Baptist reactions resulting from this interaction are submitted as data to an analytical model. For the detection of genuine Nigerian Baptist reactions, there was derived a key-factor which serves as a catalyst in determining the analytical values of those data submitted to the model. The resulting values are co-ordinated through the process of quantification and are then integrated into a graph which gives evidence of the qualitative distribution of impact factors, as they contribute to the formulation of



the Nigerian Baptist outlook. The evaluation of this evidence makes possible a determination of the range and the degree of intensity of the Southern Baptist mission impact on that portion of the Western Nigerian scene which has become identified with this mission work: the Nigerian Baptist Convention.

This methodology represents one portion of the results of this dissertation. The other set of results is provided by the evaluation of the information which was extracted from this analytical process.

This evaluation gives some insight into the range and the intensity of the Southern Baptist cultural and theological impact on the Nigerian Baptist scene:

1. Through early autonomy and timely transfer of power to their Nigerian Baptist constituency, Southern Baptists have succeeded in keeping the traditional tensions between overlords and dependents at a minimum.

2. Because of this minimum of tensions, the Southern Baptist mission impact may have prolonged effects on the Nigerian Baptist outlook.

3. The Southern Baptist domination of the theological outlook of the Nigerian Baptist Convention may serve as an example of this prolonged effect. Exceptions are the Nigerian Baptist theological and ethical expressions which have their origin in the experience of the traditional Yoruba social structure and customs.

4. Nigerian Baptists' preoccupation with the national future of Nigeria, together with the fact that they are a religious minority group, explains their adherence to a Nigerian rather than a Southern Baptist philosophical identity. The positive ecumenical spirit of the Nigerian Baptists is based upon the same phenomenon.

5. Nigerian Baptists--together with most other Nigerians--only now begin to respond to an indigenous cultural identity over against the previously accepted Western cultural identity.

6. Baptist principles of freedom and democracy and Nigerian Baptist political aspirations have not yet come into competition with one another.

Microfilm \$4.35; Xerox \$15.30. 339 pages.

#### A PSYCHOLOGICAL STUDY OF THIRTY PRAYER GROUP PARTICIPANTS

(L. C. Card No. Mic 60-3454)

Quentin Lamoin Hand, Ph.D.

Boston University Graduate School, 1960

Major Professor: William Douglas

This study was designed to investigate the types of changes in personality, social relationships, and religious beliefs and participation occurring in prayer group participants. Other purposes were the development of hypotheses for future studies and a description of the prayer group process.

Thirty participants in five prayer groups located in four southern New Hampshire Methodist churches were given selected tests and interviewed at the time of entrance into the groups. Tests used were: "Guilford-Zimmerman Temperament Survey," "Gilmore Sentence Completion Test," (McLean's) "Inventory: Social and Religious Con-

cepts," and a "Religious Autobiography" form. Of the original thirty subjects, eight dropped out of the study; the remaining twenty-two were retested and interviewed at the end of the observation period, planned to cover twenty-eight meetings. Ten subjects were retested and interviewed a third time at the end of an extended observation period of forty-nine meetings. The writer was a participant-observer, attending all meetings of three groups and occasional meetings of two groups.

The group development was similar to that of problem solving and psychotherapy groups. Each group had similar formal norms. Leadership was vested in the minister. Four groups developed cohesiveness. Groups differed in -- age and education of members, the type of interaction which occurred, satisfactions experienced by the members, and the type of leadership given. Participants said these groups differed from other small groups in the sense of unity developed, the purpose of the prayer groups, and the acceptance extended to members.

Specific types of personal change found included: changed Guilford-Zimmerman Temperament Survey trait scores, development of insight, both improvement and deterioration in social relationships, and changes in devotional practices and in felt closeness to God.

Participants were ranked according to the total number of categories showing change. The "Most" and "Least Changed" subjects were compared. The "Most Changed" were found to be a younger, somewhat better educated group. They were not quite as restrained, nor were their personal relationships ranked as high as the "Least Changed." They were more oriented to social standards, experienced more tension between Self Ideal and Self Concept, and sought to expand and change their lives.

Psychological factors found were the positive relationships between extent of personal change and: (a) age, education, and flexibility of personality structure; (b) motivation for joining a prayer group, including dissatisfaction with one's life organization; (c) relationship with the group leader; (d) acceptance by the group; (e) practice of a spiritual discipline; (f) attention to religious concepts.

The role of religion for the subjects was to provide acceptance, contribute a guiding philosophy of life, increase the aspiration level, and raise the level of frustration tolerance. Both religious growth and regression were found. A theory of religiously oriented personal change was offered.

In general, personal change occurred in subjects having relatively flexible personalities who were motivated to relate positively to others and made efforts to effect desired changes.

While Christian prayer is not primarily for personal benefit, some effects were reported. Subjects said prayer relaxed tensions and gave a sense of security. It seemed to contribute to either religious growth or fixation, depending upon the pray-er's motivation and understanding of prayer.

Prayer groups in a church program give social facilitation to religious living and stimulate personal change. Prayer groups should not substitute for "task oriented" church groups or for group psychotherapy.

Recommendations for further psychological studies included the need for improved delineations of religious development and an operational definition of religious maturity.

Religious leaders were advised to secure training in

group dynamics and spiritual disciplines. Suggestions for leading prayer groups were made.

Microfilm \$4.40; Xerox \$15.55. 341 pages.

THE RELIGIOUS A PRIORI (A CRITICAL EVALUATION OF THE PHILOSOPHY OF RELIGION OF ANDERS NYGREN, WITH PARTICULAR REFERENCE TO HIS DEPENDENCE UPON SCHLEIERMACHER).

(L. C. Card No. Mic 60-3084)

William Alexander Johnson, Ph.D.  
Columbia University, 1960

Anders Nygren's philosophy of religion was developed in the twenties in three works, *Religiöst Apriori* - 1921 (The Religious A Priori), *Dogmatikens Vetenskapliga Grundläggning* - 1922 (The Scientific Foundation for Dogmatics), and *Filosofisk och kristen etik* - 1923 (Philosophic and Christian Ethics). Nygren, however, is dependent upon Schleiermacher's philosophical orientation for his own methodological framework.

Schleiermacher's conception of religion develops during four basic periods: 1) the Youthful period (up to 1796), 2) the Intuitive period (1796-1802), 3) the Critical period (1802-1806), and 4) the Systematic period (1806-1834). Part I of the dissertation discusses Schleiermacher's thought on religion in each of these periods.

Anders Nygren's own conception of religion is dependent upon Schleiermacher's systematic period. Schleiermacher is "the philosopher of religion par preference" for Nygren, and the similarities between the two positions are obvious. Nygren develops his philosophy of religion about the concept of the religious a priori, which establishes religion as a "universal and necessary experience, inseparable from the life of man." Nygren, unlike Kant, finds a religious category in experience, which is both necessary and universally valid; necessary, because life loses significance without it, universally valid, because it makes experience as a whole possible. The religious category, or the category of eternity, is the presupposition and source of validity for all judgments and experience, but most of all for all non-religious judgments and experiences. As the philosophical method of the transcendental deduction is employed, the category of eternity is found to be the religious category, considered as a logical abstraction, which is not identifiable with a definite religion. Eternity is, therefore, absolute validity, making all experience valid. The philosophy of religion has shown, employing the method of the deduction of the categories, that its original acceptance of the witness of religion as a unique form of experience is valid. The content of religion, however, is another matter, and belongs to the sphere of historical research.

Nygren's entire system may be criticized on many points:

1. Schleiermacher has not been interpreted correctly. Nygren interprets Schleiermacher in such a way that he identifies the consciousness of God with the transcendental presupposition for theoretical knowledge and moral activity. Nygren has also constructed his religious a priori in such a way that "the transcendental necessity of religion" leads directly to the Christian faith.

2. A philosophical criticism of Nygren is relevant.

The category of "eternity" has been used ambiguously. On the one hand, eternity is "the ultimate formal category for the content of the religious experience, secondly, it is also "the foundation of validity" for religion. As a result of this confusion, Nygren's transcendental deduction of the religious category is at least ambiguous. Nygren, furthermore, confuses "truth" with "validity." Nygren replaces the concept of reality with validity. Religion is a part of culture, says Nygren, however religion is also elevated above culture, as the presupposition for all culture.

3. Nygren's significant attempt to present a relationship of "eternal Peace" between theology and philosophy offers definite opportunities for criticism. The content of the Christian faith is determined by the philosophical presupposition, rather than by the historical material of Christianity itself.

Microfilm \$4.30; Xerox \$15.10. 333 pages.

THE BLACK MUSLIMS IN THE UNITED STATES

(L. C. Card No. Mic 60-3466)

Charles Eric Lincoln, Ph.D.  
Boston University Graduate School, 1960

Major Professor: Dean Walter G. Muelder

The slow and painful progress of desegregation in America when seen in contrast with the dramatic successes the non-white peoples of Asia and Africa have experienced since World War II in their determination to be free of white supremacy, has markedly increased the frustrations and anxieties of America's Negro minority. There is a developing apprehension that it may come to pass that the American Negro will be the only people in the world still demeaned by racial subordination.

The Black Muslims represent one organized reaction to continuing patterns of discrimination in the United States and to the white man's tendency to deprecate all non-white races and cultures. They also represent an extreme protest against Christianity for its failure to treat black and white Christians with equanimity.

The study is designed: (1) to survey some characteristic defenses against the effects of race prejudice and discrimination in order to provide a perspective from which to evaluate the Muslim Movement; (2) to examine in detail the Black Muslims as a particular form of reaction to prejudice and discrimination in America; and (3) to assess the response-patterns of other Negro organizations and institutions towards the Muslim Movement and its *modus vivendi*.

The data was collected over a span of four years by means of: (1) interviews with Muslim leaders and laymen, and with Negro leaders outside the Movement such as ministers, businessmen, politicians and educators; (2) participant observation involving hundreds of hours at Muslim temples, homes, lectures, etc.; (3) reports from interested persons and institutions across the country; (4) newspaper and magazine articles by and about Muslims; (5) tape recordings of Muslim speeches and addresses; (6) Muslim pamphlets, booklets, brochures, etc.; (7) Muslim dramatic productions, pageants and phonograph records.



There are probably 100,000 Black Muslims in the United States, and the Movement is growing. There is a good deal of sympathy in the general Negro community for the Muslims, but only a relatively small number of Negroes are willing to abandon Christianity to become Muslims. Non-Muslims sympathetic to the Movement tend to concur in the belief that the white man is incapable of justice toward non-whites, and that he will never of his own accord live in a situation of equality with non-whites. Again, there is wide agreement that the white man has deliberately "written the Negro out of history" -- refusing to recognize his contributions to Afro-Asian civilization and to the development of America.

Negro intellectuals are least sympathetic to the Movement, and tend to discount it as a social force of any importance. Muslims are ambivalent toward the intellectuals, believing them to be most vulnerable to the white man's blandishments.

The Movement is essentially an expression of the Negro lower class. A few college students are Muslims, and some Muslim ministers were formerly Christian pastors. Temples are located in the large industrial cities from Boston to San Diego and from San Francisco to Miami. Converts come from a wide variety of religious backgrounds--the Methodist, Catholic, Episcopal, Baptist and Congregational churches are all represented, as are various sects and cults. Many ex-Garveyites are Muslims.

There is no apparent delinquency problem among Muslim children. The father is restored as head of the family. Notable success in rehabilitating ex-convicts, alcoholics and narcotic addicts is reported. Parochial schools are maintained by some temples.

The Muslims anticipate the eventual destruction of the white man, and the re-establishment of the Black Man's Civilization. They advocate non-violence except in self-defense, when the *lex talionis* is held to apply. Complete separation of the races--and a "United Front of Black Men" are fundamental precepts.

The Black Muslims probably constitute a Moslem sect in spite of their doctrinal deviations. Some Muslim leaders have made the traditional pilgrimage to Mecca.

Microfilm \$5.25; Xerox \$18.45. 410 pages.

#### METHODISM AS AN INITIATOR OF SOCIAL THOUGHT AND ACTION IN THE AREA OF WORLD PEACE (1900-1956)

(L. C. Card No. Mic 60-3467)

Robert Paul Lisensky, Ph.D.  
Boston University Graduate School, 1960

Major Professor: Walter G. Muelder

#### Statement of the Problem

The central aims of this study are to analyze the sociological significance of Methodism as an initiator of social thought and action in the area of world peace, and to find what effect the position held by Methodism has had on the changing attitude toward war in the twentieth century.

#### Procedure

The method of the dissertation is empirical, with an

appeal to rational coherence as the means of interrelating the data. The criteria of social thought and action developed in Chapter One serve as the tool for making a qualitative analysis of the social programs of the churches. Chapter Two briefly traces the historical setting. In Chapter Three attention is given to the role taken by The Methodist Church, while Chapter Four deals with the part that Methodism has played in relation to national and international ecclesiastical organizations involved in the struggle for world peace.

#### Summary

The criteria cover six areas: (1) Range of Emotional Tone; (2) Range of Content; (3) Range of Responsibility; (4) Range of Community; (5) Range of Relevance; and (6) Range of Involvement. Each area is developed along a continuum in order to determine the degree of accuracy.

In the early 1900's there was a great interest in isolationism and peace sentiment. Both these movements went into hibernation during World War I, only to return in the 1920's. The peace sentiment of the 1920's brought with it a concern with international affairs, which enabled the churches to maintain a universal theme in World War II and to preserve the harmony of the pacifist/non-pacifist camps. Following World War II the American people displayed a new concern for world affairs. The churches served as one of the causes for this change.

This interest in world affairs was the by-product of the sect type tendencies found within some of the agencies of the major denominations and of the denominations' attempt to support a universalist religion. The uncompromising appeal to ethical ideals is apparent in such agencies of The Methodist Church as the Commission on World Peace, the Woman's Society of Christian Service and the Methodist Federation for Social Action. The attempt to educate Methodists concerning international affairs is evident in the work of the two Methodist Crusades for World Order and of the Board of Education.

This desire to be informed and involved in the decision-making policies is seen in the work of the Department of International Goodwill and Justice of the Federal Council of Churches in America. The World Council of Churches has also sought peace through its attempt to mold world opinion and to express the consensus of its constituents.

#### Conclusions

1. Methodism has been an initiator of social thought and action in world peace: by creating the first Board among the major denominations with the specific purpose of the achievement of world peace; by being the only major denomination to serve on the National Board of Civilian Service; by leading the Crusade for a New World Order to win acceptance for the United Nations; by educating for international understanding in the programs of the Church; and by providing leadership and at times direction to national and international organizations working for peace.

2. There has been a decided shift on the part of the churches in their degree of involvement in war.

3. The emphasis of a universalist religion was maintained throughout World War II and the post-war years.

4. The churches have become deeply involved in the responsibility to move from guiding principles to political propositions and to bring a Christian influence to bear on international events.

Microfilm \$4.60; Xerox \$16.20. 357 pages.

**SOCIAL IDEAS OF METHODIST MINISTERS  
IN ALABAMA SINCE UNIFICATION**

(L. C. Card No. Mic 60-3477)

Charles Marion Prestwood, Jr., Ph.D.  
Boston University Graduate School, 1960

Major Professor: Walter G. Muelder

The problem of the dissertation is to ascertain the social ideas of Methodist ministers serving in the Birmingham Area of The Methodist Church from 1939 to 1960; to discover the origin of these ideas and their development historically; to make an analysis of these ideas in the context in which they develop; and to discover what hypotheses are most adequate to account for the development of these ideas.

Methodologically the study depends primarily upon the historical method, which is supplemented by the use of interview, observation, and a questionnaire entitled "Beliefs of Methodists."

It was found that the social ideas of Methodist ministers were expressed primarily in the areas of temperance, the relationship of church to state, world order and related topics, and race relations. In the presentation of all social ideas except race the ministers demonstrated a marked uniformity of opinion. There is considerable tension among the ideas of ministers as they relate to race relations.

The sources and methodology provided a basis for the following summary descriptions of the social ideas of the ministers. The Methodist ministers of Alabama produced more statements on temperance than on any other segment of a social ideology. The written sources and the questionnaire indicated that there was almost uniform opinion among the ministers that members of society should abstain from the use of alcoholic beverages. To implement these social ideas the ministers used a variety of means ranging from homiletics to organized pressure on state and national politicians.

The primary statements defining the relationship of church to state were developed during the period in which there were attempts by various groups to direct public tax money to the support of Roman Catholic schools and to have an ambassador appointed to the Vatican. The ministers of Alabama consistently opposed the appointment of an ambassador to the Vatican and the allocation of public funds to Roman Catholic schools. Beyond these two issues the ministers produced few statements which dealt with the relationship of church to state.

As early as 1939 the ministers of Alabama were defending the organization of a form of world order similar to that later developed in the United Nations. The ministers were united in their defense and evaluation of the United Nations. Although the ministers defended the creation of the United Nations, they considered war as a legitimate means of preserving "the American way of life." Again, however, the ministers developed no ideological statement of world order which included more than a support of the United Nations and the legitimacy of the entrance of the United States into World War II.

The most difficult social ideas to ascertain and evaluate were those which were concerned with an ideology of race relations. Only three ministers produced articles during the period under consideration which defended an

ideology of white supremacy, and only 1.0 percent of the respondents to the questionnaire indicated that they held an ideology of white supremacy. On the other hand only 11.7 percent of the respondents to the questionnaire indicated that they thought all discrimination based on race should be abolished, and 8.0 percent indicated that they thought that racial segregation should be abolished at all levels in The Methodist Church. Furthermore, there was no article produced by any minister of the Area which defended integration as Christian or desirable. The study demonstrated that the ideology of race relations is defined by the ministers in terms which suggest segregation or permissive legislation rather than white supremacy or integration. The statements produced by the ministers are produced in a social and political dynamic which makes them difficult to evaluate as sources of the social ideas of the ministers.

Microfilm \$5.65; Xerox \$20.05. 443 pages.

**A STUDY OF SOUTHERN BAPTIST LANDMARKISM  
IN THE LIGHT OF HISTORICAL  
BAPTIST ECCLESIOLOGY**

(L. C. Card No. Mic 60-3152)

James E. Tull, Ph.D.  
Columbia University, 1960

This thesis is a study of the Landmark Movement, which arose among Southern Baptists near the middle of the nineteenth century. The author, prophet and statesman of the movement was James Robinson Graves (1820-1893). Graves was born in Vermont, but in his early maturity he settled in Nashville, Tennessee. Nashville was the virtual capital of the Landmark Movement until the Civil War.

Graves early associated himself with two other men--James Madison Pendleton (1811-1891), and Amos Cooper Dayton (1813-1865). These three men, known by their followers as the "Great Triumvirate," were the principal leaders of the movement during its earliest and most formative stage.

After the Civil War, the ecclesiological emphases of the Landmarkers, under the continuing leadership of Graves, gradually and deeply infiltrated the life and policy of Southern Baptists. After Graves passed away, Landmarkism continued to thrive in the denomination, until it became a dominant factor in the denomination's total life. Today, Landmarkism still enjoys great strength, particularly in Kentucky, Tennessee, Alabama, and the states of the Southwest. It has manifested also considerable strength in the denomination's westward and northward advance.

The Landmark Movement was and is an extremely sectarian movement which, in its beginning stages especially, attempted to call Baptists back to what were conceived to be the historic tenets (the "Old Landmarks") of their faith. The powerful Landmark admonition to the Baptist community was attended by a bitter and continuous battle against other denominations, especially against those Protestant denominations with which the Baptists were thrown into closest contact.

This study has three principal objectives. The first is to set forth the ideas of the Landmark Movement in



historical context. The second is to show that the peculiar tenets of the Landmark system, instead of representing the historic principles of the Baptist people, were in fact, in each case, an historical departure from Baptist traditions. The third objective is to trace the course of the movement as it permeated the life of the Southern Baptist denomination, until it came to exercise a dominating influence therein. Since the Landmarkers claimed that "all true Baptists" in all ages of history have held to Landmark principles, it should be pointed out that the heart of this study is in the discussion of objective number two, stated above.

The main ecclesiological convictions of the Landmarkers were twofold. The first concerned the nature of the church. The Landmarkers held that the church is local only; that the kingdom of God is identical with the totality of Baptist churches; and that Baptist churches have enjoyed an unbroken historical succession from the time of Christ. A corollary of this point of view was that all "religious societies" which were not built upon the constitution commanded by Christ, and which lay outside this visible succession of local churches, were not authentic gospel churches.

The second main ecclesiological conviction of the Landmarkers was concerned with the authority of the church. They held that upon the church alone, by divine mandate, rested the responsibility for all "gospel acts," namely, the preaching of the gospel, and the celebration of baptism and the Lord's Supper.

Upon Landmark premises, it followed that the "gospel acts" performed by non-Baptist "societies" were invalid. Their churches, so-called, were spurious. Their ministers lacked authentic authorization to preach and to administer the ordinances. Their baptisms, lacking proper administrators, proper mode and proper design, lacked authenticity. Their communion services, devoid of proper church authorization, were invalid.

It must be acknowledged that Baptist traditions have been diverse, and that some of them have been radically sectarian. Points of kinship between these sectarian expressions and the views of Landmarkism have been pointed out repeatedly in this thesis. Yet the main task has been to show that Landmarkism has diverged significantly from Baptist traditionalism (or traditionalisms) with respect to every important point.

Microfilm \$9.20; Xerox \$32.75. 727 pages.

THE PSYCHODYNAMICS OF CHANGE IN RELIGIOUS  
CONVERSION AND COMMUNIST BRAINWASHING:  
WITH PARTICULAR REFERENCE TO THE  
18TH CENTURY EVANGELICAL REVIVAL AND THE  
CHINESE THOUGHT CONTROL MOVEMENT.

(L. C. Card No. Mic 60-3492)

Duane Arlo Windemiller, Ph.D.  
Boston University Graduate School, 1960

Major Professor: William Douglas

1. Statement of the Problem

The problem of this dissertation is to compare the psychodynamics of two phenomena, Chinese Communist

brainwashing and the emotional upheaval type religious conversion (as it is observed in the 18th century Evangelical Revival).

Because of certain similarities such questions as these arise: Have churchmen in the name of religion used methods and techniques which when turned to other ends, earn their own condemnation? Do the similarities exist only on the surface or do they indicate a deeper relationship? Will current investigations into the psychology of brainwashing lead to a critical re-examination of the emotional upheaval type of religious conversion resulting from mass techniques? The clarification of these relationships and questions is the task to which the dissertation is dedicated.

2. Procedure

One chapter each is given to tracing the psychodynamics and stages of development in brainwashing and religious conversion. The influence of the Chinese culture on the methods of brainwashing is shown. A typical Revolutionary College is pictured in action from the entrance of an "intellectual" to his "brainwashed" exit six months later. The techniques, purposes and effects are summarized and the resulting picture compared with other forms of brainwashing, namely Russian and German. Finally the general psychodynamics are enumerated.

The chapter on religious conversion develops a working definition of conversion through consideration of different definitions and descriptions given by selected psychologists of religion. In addition, different types of conversion are described and analyzed in terms of dynamics and phases. Then after tracing the social background of the 18th century Evangelical Revival, the central figure, John Wesley, with his methods is described. Several diaries and memoirs of persons converted in the revival are analyzed and collated to indicate the nature of the various stages in a conversion experience. The feelings and effects are listed by phases and an attempt made to describe the nature of the seeking that holds a convert in the grip of emotional upheaval until released by conversion.

The third chapter is given to an investigation of the General Adaptation Syndrome. This basic pattern of a stress reaction is set forth in order to compare it with the two phenomena under investigation, in the hope that it will help clarify the nature of and relation to each other of religious conversion and Chinese Communist brainwashing.

3. Conclusions

Brainwashing and conversion, along with the G. A. S., may be called stress reactions, since each progress from conflict to adaptation to exhaustion and submission.

Of thirty-six procedures noted twelve are used by both disciplines. Brainwashing and conversion are quite dissimilar here.

Of the effects produced by the procedures, twenty of the thirty-two were identical. The two phenomena are quite similar in their effects.

The psychodynamics of the two phenomena are nearly parallel.

The two experiences are widely divergent with respect to the amount and nature of the force which holds the subject in the psychodynamic pattern to its conclusion.

The content of the two experiences is quite dissimilar,

it being spiritual and emotional in conversion and political and mundane in brainwashing.

The purposes and goals are in opposition. One aims at a restored relationship with God, the other at a corrected relationship with the economic imperative.

Both disciplines are highly structured in organization and both make use of group dynamics to attain their goals, though the attitudes of the operators put the phenomena in

opposite camps. In one is found love and sympathetic prayer, in the other, unfeeling ego assault.

In summary: (1) religious conversion of the "upheaval" type and Chinese Communist brainwashing are similar with regard to the psycho-biological process involved; (2) they are very dissimilar in content, purposes, goals, motivation and the differing views of the nature of man and society. Microfilm \$2.50; Xerox \$8.60. 186 pages.

## SOCIAL PSYCHOLOGY

CONCEPTS OF MASCULINITY, A STUDY OF  
DISCREPANCIES BETWEEN MEN'S SELF-CONCEPTS  
AND TWO DIFFERENT IDEAL CONCEPTS AND  
THEIR RELATIONSHIP TO MENTAL HEALTH

(L. C. Card No. Mic 60-3740)

Otto Ehrenberg, Ph.D.  
New York University, 1960

Supervisor: Professor H. Harry Giles

The study dealt with men's perceptions of three different concepts of masculinity (self-concept, contemporary ideal man concept, traditional ideal man concept), and the effect of patterns of similarity and dissimilarity among these concepts of their degree of mental health. Its basis was the belief that a new conceptualization of the masculine role has emerged in modern society, applying to white collar men at least, which calls for behavior and personality attributes markedly different from those associated with the traditional concept of masculinity. This new role demanded by modern society is one that emphasizes impulse-restraint and conformity to external societal demands as compared with traditional descriptions of masculinity which emphasize more impulse-expressive, individualistic personality traits. It was felt that, as a result, today's white collar man is faced with a serious conflict between the demands of the contemporary masculine role expected of him by society and the residual traditional role of masculinity which still influences his value-system.

The specific hypotheses which guided the study were that men's contemporary and traditional ideal man concepts differ from each other, that men's traditional ideal man concepts contain a greater degree of impulse-expressive characteristics than their contemporary ideal man concepts, and that the greater the relative difference between a man's self-concept and his traditional rather than his contemporary ideal man concept, the poorer is his state of mental health.

The sample of this study consisted of 49 upper middle class men, between the ages of 25 and 50 years, who were employed by organizations in the metropolitan New York area. This type of sample was selected for study because the role conflict problems under investigation are generally believed to be most acute in this segment of the male population.

Measurement of the three concepts of masculinity was

accomplished by use of rating scales incorporating a personality attribute list developed especially for this study. These concept rating scales demonstrated reasonable reliability and validity under the conditions of this experiment. Men's state of mental health was measured by use of the Winne Scale of Neuroticism. The subjects were assured of anonymity throughout the testing procedure to encourage uninhibited responses.

The findings demonstrated that men's self-concepts differ from both the ideal man concepts. However, the content of the two ideal man concepts differs. The traditional ideal man concept contains a much greater proportion of impulse-expressive than impulse-restraining attributes, and the contemporary ideal man concept contains a much greater proportion of impulse-restraining than impulse-expressive attributes. Men whose self-concepts deviate more from their traditional rather than from their contemporary ideal man concepts score significantly higher on the Winne Scale of Neuroticism than men whose self-concepts deviate more from their contemporary rather than their traditional ideal man concepts.

On the basis of these findings, it was concluded that impaired mental health in men is indeed related to a conflict between two ideals of masculinity, the traditional and contemporary. In particular, the findings indicate that to the extent that men compromise the demands of the traditional (self-expressive) role for the sake of the contemporary (self-restraining) role their mental health, and thereby, ultimate personality fulfillment, is adversely affected. These results were discussed in terms of their implications for men's personality development, and for the welfare of society as a whole.

Microfilm \$2.50; Xerox \$5.20. 102 pages.

STYLISTIC COMPONENTS OF RESPONSE  
AS RELATED TO ATTITUDE CHANGE

(L. C. Card No. Mic 60-3094)

Edward B. Klein, Ph.D.  
Columbia University, 1960

In his review of studies dealing with attitude change toward ethnic groups after exposure to propaganda, Rose found that twice as many studies resulted in change than no change. In all of these relatively standardized situations



some subjects change positively, some contrary to expectation, and some not at all. However, most of these attitude change studies have only dealt with mean differences in attitude shifts between experimental and control groups, but not with the psychological characteristics of the changers and non-changers. Recently researchers have begun to examine personality differences among subjects. This research suggests that insofar as response set and other stylistic components reflect deeper psychological variables they may help in predicting which individuals will change and in what direction. The present study investigates the relationship between the stylistic components of response and attitude change after exposure to propaganda.

The experimental sample consisted of 611 students from the following regionally selected colleges: Hunter, Northwestern and North Carolina. The control group consisted of 203 Ss from the same schools.

All subjects were tested on the F scale and an adaptation of Osgood's Semantic Differential focusing on the Negro. A pro-Negro film was then shown to experimental Ss while control Ss had a regular class period. Administration of a parallel form of the Semantic Differential followed for all Ss.

Christie's version of the F scale yielded a content measure of authoritarianism and the following three stylistic scores:

1. Agreeableness, the tendency to agree with incompatible scale items.
2. Scatter, a measure of the S's consistency of response with regard to the underlying dimensions of the scale.
3. Extremity, a measure of the individual's variation around the scale mean.

The F scale, even with the limited range of scores imposed by the sample, was a good measure of authoritarianism. It discriminated between samples drawn from authoritarian and non-authoritarian sections of the country on a number of content and stylistic variables as well as the correlations between F content and prejudice scores.

The Semantic Differential was a sensitive measure of attitude toward the Negro as shown by the significantly more negative attitude displayed by the Southern sample. The film also produced positive attitude change in the experimental groups in each of the three colleges investigated.

The stylistic variables are useful for categorizing Ss into personality groups. This was supported by the finding that greater ideological organization was displayed by extreme scorers than middle range F groups and that agreeableness played a greater role in Inconsistent than Consistent extreme groups.

Even though the High and Low groups were only relatively extreme scorers there was a tendency for polarization to occur among Consistent extreme groups.

There was also a tendency for consistency of response to carry over from the personality area as measured by the F scale variables into attitude on the Semantic Differential.

Two rather unexpected findings are reported. First the low correlation between F content score and attitude toward the Negro, which appears to be due to the inclusion of a neutral category on the Semantic Differential, and the changing times. The second unexpected finding was that there was no greater change on relevant than irrelevant items on the Semantic Differential for all groups studied.

The implications of these findings for an understanding of the role of personality variables, as reflected by stylistic components of response, in attitude change were discussed. Microfilm \$2.50; Xerox \$6.40. 131 pages.

#### THE AUTHORITARIAN PERSONALITY: ASSESSMENT OF THEORY AND METHODS.

(L. C. Card No. Mic 60-3233)

David Walter McKinney, Jr., Ph.D.  
The University of Wisconsin, 1960

This investigation stems from a persistent curiosity regarding why inquiries in some areas of investigation produce demonstrable knowledge, while in other areas, most notably the social sciences, inquiries of comparable ingenuity have yielded no similar results. With the view to achieving some measure of understanding of this problem the investigation began with a search for the solution to the following question. Why have social science inquiries failed to yield a body of demonstrable knowledge? During the course of the initial search it was deduced that the approaches to social science data are inadequate for the task for which they are being employed. This inadequacy was postulated to consist in the failure to fulfill the requirements induced by the initial and corollary assumptions entailed in the broad bodies of data in question. More specifically, the inadequacy was hypothesized to be due to the failure of theory, methodology, specific techniques and procedures to comply with the requirements induced by the initial and corollary assumptions entailed in the broad body of data for which the specific unit of study represents an instance. Conversely, in accordance with this hypothesis, it was postulated that adequacy of an approach to social science data must entail coherence in and between the chain of steps presumed to be relevant to theoretical problem solutions. Correspondingly, for coherence in and between the chain of steps to exist, the direction taken by the latter must be determined by the initial and corollary assumptions underlying the broad body of data in question. Hence, if the direction taken by the chain of steps is determined by these initial and corollary assumptions, then, these assumptions will determine: (a) the direction and lines along which the requisite theory is required to be formulated; (b) the type of methodology required; and (c) the choice from which the specific research techniques and procedures (to be employed in observation, collection, and processing of relevant data) are to be drawn--in order to be congruent with the requisite methodology in terms of which their legitimacy is established. Accordingly, it was reasoned that the failure of prevailing approaches to social science data to yield a body of demonstrable knowledge may lie less in the legitimacy (validity) of each (i.e., taken separately) specific technique or procedure, than in whether or not they, as a chain of steps, cohere; and/or whether or not, the initial and corollary assumptions determining their direction are congruent with the body of data in question.

To test the preceding postulate a representative instance of an approach to a body of social science data was chosen for critical analysis. The studies chosen for this purpose consisted of all empirical investigations published in the United States between 1950-1957, employing a

specific type of approach to the study of authoritarian personalities. Using these studies as a representative instance of the proficiency characterizing approaches to broad bodies of social science data, an analysis is made of these studies to determine whether the theory, methodology, research techniques and procedures employed comply with the requirements induced by the initial and corollary assumptions which underlie their approach.

The character of the inquiry required a separate treatment of the specific requirements for fruitful investigation of the authoritarian personality, on the one hand, and the actual substantive body of "theory" and research employed, on the other. The former was then utilized as independent criteria for assessing the legitimacy and adequacy of the procedures employed in the latter. These two separate treatments necessitated the utilization of different methods of treatment. To determine the specific requirements with which it was necessary to comply in the actual implementation of theory and research the method of deductive elaboration was employed. To obtain the required relevant information concerning the substantive body of theory and research an outline ("Questionnaire," as it were) was used. Through the use of this outline the relevant information was abstracted from the "test" studies.

It was demonstrably established that there exists a pronounced lack of congruence in and between the procedural steps involving and comprising the Investigators' "theory," methodology, specific techniques and procedures. Therefore, to the extent that the authoritarian personality studies do in fact consist of a representative instance of proficiency characterizing approaches to social science data in general, the postulate is confirmed.

Microfilm \$6.80; Xerox \$24.10. 533 pages.

#### SELF AND SOCIAL PERCEPTION OF GIFTED AND TYPICAL CHILDREN

(L. C. Card No. Mic 60-3959)

Robert Vern Miller, Ph.D.  
University of Illinois, 1960

The problems were to determine if there were differences between gifted and typical groups at each of grade levels 5, 9 and 11 in 1) their self acceptance (SC), acceptance of the ideal person (ISC), predicted acceptance by others (PSC), actual acceptance by others (A by O) and acceptance of others (A of O) and 2) the extent to which selected pairs of these variables were correlated. The gifted were defined as those having group intelligence test IQs greater than 1.5 sigmas above the mean for the school population; typical as within  $\pm .6$  sigmas about this mean. All of the variables listed above were operationally defined in terms of evaluative ratings on a five point scale of twenty personality traits selected for their high factor loadings on Cattell's twelve "source" traits (1946).

It was postulated that since both gifted and typical seek high positive self concepts and the gifted have greater support for this in reality, they would tend to be more reality oriented and modest while the typical would be more delusional and compensatory in their ratings of themselves, the ideal person and assumed acceptance by others. The null hypothesis was tested for each of the problems listed above.

Classes were selected having a relatively large number of gifted and/or typical students until 25 gifted and 25 typical subjects were identified per grade level. In each class students were given four sets of the twenty personality traits and instructions such that each set was rated on a different basis to provide a different measure for each variable.

For both gifted and typical groups at each grade level these tests were run: 1) Anova for differences between the gifted and typical in usage of scale points for SC, PSC and ISC. 2) U test for differences between gifted and typical groups on each of the variables. 3) Rhos between selected pairs of variables and z test for differences between respective rhos for gifted and typical groups. 4) U test for differences between gifted and typical groups in absolute discrepancies between the selected pairs of variables. 5)  $X^2$  test of the frequencies with which one variable of a selected pair exceeded the other.

The results were as follows:

1. The 11th grade typical were more self accepting than the gifted. The 5th and 11th grade typical used the scale points differently from the gifted.
2. Ninth grade gifted rated the ideal person more favorably than did the typical.
3. The 5th and 11th grade gifted were more accepted by others than the typical at these levels.
4. Self acceptance and acceptance of the ideal person were correlated<sup>1</sup> for 5th grade typical. The latter was rated more favorably than the former by all groups.
5. Self acceptance and assumed acceptance by others were correlated for all groups. Correlation greater for gifted than typical at 5th grade. SC greater than PSC for typical while the reverse was true for 11th grade gifted.
6. Self acceptance and acceptance of others were correlated for 5th grade typical. A of O greater than SC for gifted; the reverse true of typical.
7. Assumed acceptance by others and actual acceptance by others were correlated for 9th and 11th grade gifted. PSC was greater than A by O for typical; reverse true for gifted.
8. Assumed acceptance by others and acceptance of others were correlated for 9th and 11th grade typical.
9. For gifted, A by O was greater than either SC or A of O; reverse is true of typical.
10. All other results were not significant.

Finally, some results were discussed, some theoretical postulates were modified and some needed research was cited.

1. Always means "statistically significantly correlated."  
Microfilm \$2.50; Xerox \$5.60. 114 pages.

#### THE RELATION OF SOCIAL REFERENCES TO IMAGERY OF OCCUPATIONAL LIFE STYLES

(L. C. Card No. Mic 60-3422)

Howard Alex Rosencranz, Ph.D.  
Michigan State University, 1960

Major Professor: William H. Form

The purpose of this study was to examine the perceptions of people relating to four aspects of behavior associated with seven specific occupations: Assembly Worker,



Carpenter, Bookkeeper, Salesman, Sales Manager, Teacher, and Doctor. For each occupation inquiry was directed toward imagery concerning work related characteristics, family and home patterns, consumption patterns, and social and activity patterns. Together these reflect what might be termed an occupational life style.

A secondary objective was to ascertain whether these images were affected by selected background characteristics of the informants: age, sex, size of community, father's occupation, newspaper readership, academic standing, and college major. The chi-square test of significance was used as a measure for evaluating differences in perception. Comparison of perceptual data with actual occupational information was made, when possible, as a measure of image realism.

Assembly Worker data showed that the type of image most often significantly different was related to family and home patterns; the most discriminating variable was sex of informant. The Assembly Worker was given a low status position and was thought to be unhappy with his work. Perceptions most nearly coincident with verifiable characteristics were income estimates, family size, monetary worries, chain-store buying, political preference, and limited mobility.

Images most often significantly different for Carpenter fell in the category of social and activity patterns; size of community was the most differentiating variable. He was thought to be happy with his work, not likely to prefer other work, and particularly concerned with "good workmanship." Respondents overestimated his income, education, consumer goods, but were more nearly accurate about his organizational activities and size of family. The Carpenter ranked high in esteem.

Family and home patterns were most often significantly different for Bookkeeper, while sex of informant was the most distinguishing variable. Although the Bookkeeper was thought to have had more education and moderately high occupational class origins, he rated low in general prestige, income, and material goods. He was often pictured lower than the Salesman and on a par with Assembly Worker.

Work related characteristics were most often significantly different for Salesman; size of community was the most discriminating control. The Salesman was assigned a middle-range income, an average amount of consumer goods, and a high school education. He was thought to be a Protestant and was ascribed a wider circle of friends than the blue collar occupations or the Bookkeeper.

Most often significantly different for Sales Manager was the category of social and activity patterns; academic standing was the most differentiating variable. He was thought to have a high income, to be happy in his work, to

be a Republican, and most geographically mobile. He was given socio-economic ascriptions second only to Doctor. Perceptions for the Sales Manager showed great variation, yielding an element of ambiguity.

Social and activity patterns were most often significantly different for Teacher; size of community was the most discriminating variable. Although low economic expectations were accorded the Teacher, he was believed to have access to cultural amenities beyond his income. He was considered geographically mobile, a Protestant, dedicated to his job, but quite likely to change his occupation.

The type of image most often significantly different for Doctor was social and activity patterns; sex of informant was the most distinguishing variable. He was given the most favorable image in terms of monetary rewards, material possessions, devotion to and happiness with work. He was thought to have professional family origins and to be most deeply rooted in his community. All expected his children to go to college; nearly all expected his sons to pursue professional careers.

Three of four major hypotheses were substantiated:

1. Occupational images differed significantly at the .05 level or less in regard to sex, size of community, and age of informant. Sex was a discriminating variable for all occupations; size of community for all except Sales Manager. Age discriminated only for Sales Manager.
2. Occupational images differed significantly in respect to college major for four occupations. For example, education majors perceived the Teacher differently.
3. Informants who were upwardly mobile differed significantly from those who had fathers in the white collar group. This was found in relation to perceptions for Carpenter, Bookkeeper, and Salesman.
4. The principle of "status congruity" did not hold up in analysis. More realistic images were not perceived for the white collar occupations by students whose fathers had white collar occupations using at least two evaluative criteria.

When all seven occupational images were compared, the postulated levels of prestige ranking appeared in about one-fourth of the comparisons; notable distortions occurred in almost one-third of the comparisons.

It can be concluded that people are able to project highly detailed, realistic ideas about occupations, this ability was further attested by small categories of no response. Perceptions were distinct in differentiating one occupation from another. Data also suggest that aspirations are more nearly related to occupational imagery than is occupational background of informants.

Microfilm \$4.20; Xerox \$14.85. 328 pages.

## SOCIOLOGY

### SOCIOLOGY, GENERAL

#### OCCUPATIONAL SPECIALIZATION AND SOCIAL MOBILITY

(L. C. Card No. Mic 60-4737)

Earl Bogdanoff, Ph.D.  
Northwestern University, 1960

Adviser: Professor Raymond W. Mack

This study raised the question: What relationship exists between occupational specialization and the phenomenon of upward social mobility in the United States?

A theoretical model was developed to generate hypotheses for this major dissertation question. Essentially, the model suggests that individuals will strive to obtain specialized occupational roles in order to rise in the stratification structure. Or stated as a formal hypothesis: Engaging in occupational specialization is a predominate method individuals have used to become upwardly mobile in American society.

The testing of the above hypothesis involved abstracting, from the theoretical model, a series of sub-hypotheses which, if validated, would produce a strong inference that our major hypothesis is correct. The research involved the use of three specific instruments: A. The construction of an original tool to observe and measure the nature and extent of occupational specialization; B. The Alba Edwards socio-economic occupational classification; C. The North-Hatt prestige scale.

The various theoretical sub-hypotheses were translated into a series of operations (operational hypotheses). 9,892 "father-son" occupational categories were obtained from Miss Rogoff's 1940 occupational mobility study.<sup>1</sup> The categories were then assigned classification numbers for both the Edwards socio-economic classification and the specialization scale. Chi-square "goodness-of-fit" tests were made on each operational hypothesis. A "pilot exploratory" study was also made on a group of professional people to gain further knowledge concerning the concepts of occupational prestige and occupational specialization.

The decision-making devices used in the research accepted two hypotheses as stated, rejected three and modified three. On the basis of these tests the following conclusions were made:

I. The higher the degree of occupational specialization, the higher the degree of prestige accorded it.

II. Individuals who are judged to have experienced the greatest amount of upward occupational mobility will generally be found in occupational roles which are relatively high in occupational specialization.

III. If the father's occupational role is low in socio-economic status and occupational specialization, and the son is upwardly mobile then: (a) the son's occupational specialization will increase as he increases his socio-

economic movement upward from the father, (b) the son's occupational specialization will be higher than the father's.

IV. The most typical upward intergenerational relationship existing is for the father to have a low socio-economic status and a low specialization role and his upwardly mobile son to have a relatively low degree of occupational specialization.

V. The condition which will contribute least to the total number of upwardly mobile sons is one in which the fathers have a high socio-economic status and a high degree of specialization giving rise to sons who engage in low degrees of occupational specialization.

On the basis of the research our major theoretical hypothesis was modified to read: Engaging in occupational specialization is the method individuals have used to obtain significant changes in their style of life from that of their fathers.

The specific contribution which the researcher believes this dissertation has made to sociological knowledge is in terms of suggesting a relationship existing between the variables: occupational specialization and social mobility. A contribution to sociological research has been made through the creation of a research tool to identify and measure the nature and extent of occupational specialization.

1. Natalie Rogoff, Recent Trends in Occupational Mobility, Glencoe, Illinois: The Free Press, 1953.

Microfilm \$2.50; Xerox \$7.60. 165 pages.

#### PATTERNS OF SUICIDE IN PHILADELPHIA: 1948-1952.

(L. C. Card No. Mic 60-3568)

Donald Richard Campion, Ph.D.  
University of Pennsylvania, 1960

Supervisor: Marvin E. Wolfgang

Through the centuries writers have dealt with the theme of suicide. With the rise of the social sciences in the 19th century, new efforts were made to uncover meaningful patterns in the personalities and background of those taking their own lives. The literature reveals, however, that our knowledge about many aspects of suicide remains limited and uncertain. The purpose, then, of the present research was twofold: (1) to increase the fund of exact knowledge about suicide by a careful and exhaustive investigation of a large number of suicides in one community; (2) to compare the results of this investigation with those reported in other studies.

This work deals with 894 cases of suicide certified by the Medical Examiner in Philadelphia during a five-year period, 1948-1952. The pertinent information came from



the records of the Medical Examiner's office. It was coded and punched on IBM cards for subsequent tabulation and correlation. Tests for statistical significance were applied.

A special feature of this research is the initial survey of writings in several languages on the subject of suicide. This provided a perspective with which findings about suicide in Philadelphia might be more intelligently examined. Throughout the research, new findings were compared with those reported in the United States and elsewhere.

Philadelphia's suicide rate is low in comparison with rates for most major cities. Its sex differential rate, however, corresponds to that observed in other populations. This difference between the sexes is seen to be notably greater than that between the two major racial groups in Philadelphia, whites and Negroes. The average age of Negro suicides is considerably lower than that of whites, but the computation of age-adjusted rates revealed that this apparent difference was largely a reflection of an underlying difference in the age composition of the two groups. The remarkably high rates observed among foreign-born whites likewise proved, on analysis, to be largely the manifestation of that group's distinctive age composition.

Suicides in Philadelphia, as elsewhere, appeared with special frequency in the ranks of the widowed, separated and divorced. In this respect, the Negro suicides seemed to differ from the general population. It was suggested, however, that this difference may reflect differences between groups with respect to cultural definitions of marital situation rather than any true difference in relative proneness to suicide.

Among other aspects of suicide examined in this study were the degree of social isolation to which suicides were exposed and the temporal and spatial patterns characteristic of suicides committed in Philadelphia. In several instances, findings pointed to the need for caution in perpetuating traditional notions about favorite times and places for suicide. With respect to the choice of method or means, Philadelphians revealed a marked preference for hanging. Among them, distinctive race, sex and nationality preferences were also observed.

The study concluded with a list of areas of suicide research which experience in the present study and a critical evaluation of the literature indicated were in special need of further investigation.

Microfilm \$4.35; Xerox \$15.30. 337 pages.

**ROLE CONCEPTION AND MOBILITY ASPIRATION:  
A STUDY IN THE FORMATION AND  
TRANSFORMATION OF BUREAUCRATIC,  
PROFESSIONAL AND HUMANITARIAN  
NURSING IDENTITIES.**

(L. C. Card No. Mic 60-3505)

Ronald Gary Corwin, Ph.D.  
University of Minnesota, 1960

A contemporary and historical review of nursing discloses conflicting trends toward bureaucratization and professionalization, both detracting from the traditional importance of humanitarianism. Resulting confusion is

manifested in the variety of available nursing role conceptions, which poses personal dilemmas and creates conflicts of loyalty to the profession, the hospital, and the patient. The thesis is that these role conceptions, their organization, crystallization and deprivation, effect the nurse's identity and consequent loyalties and ambitions.

The sample consists of 289 graduate and student nurses selected from seven hospitals of varying size and affiliation, and four diploma and degree schools of nursing located in an upper mid-western metropolitan area. Respondents were administered questionnaires consisting of bureaucratic, professional, and service Likert-type scales pre-tested by the internal consistency method and designed to measure the extent to which each role conception is held. Each scale consists of six to eight hypothetical situations in which a nurse might find herself. Respondents indicated the extent they believe each situation should be ideal for nursing. Weighted responses, ranging from strongly agree to strongly disagree, constitute the respondent's role conception scale score. Role certainty is computed as the proportion of responses at the extremes (strongly agree or disagree). Disillusionment is estimated from differences in the mean favorableness in role conception for categories of personnel in nursing different lengths of time. Extent of role deprivation is the mean of the differences between the respondent's estimate for what is the case in nursing and his normative response for each situation.

The problem of formation and transformation of role conception of nurses and student nurses is explored with particular reference to the type of training program. A professional-bureaucratic typology is introduced. It was found that diploma and degree personnel form different types of role conceptions and organize them and maintain and change them in different ways after graduation. Diploma personnel are more easily disillusioned about the professional role conception, while degree personnel maintain a professional conception in the face of its deprivation, becoming disillusioned over bureaucratic and service role conceptions. It was concluded that degree personnel are more professionally oriented, while diploma personnel consistently display more loyalty to the hospital administration.

Tests of association indicate that role conception, its clarity and deprivation have definite, and in some cases important, influence on teaching and promotion ambitions and the migration plans of nursing personnel. But the pattern appears consistent only when the concept of identity is introduced as a way of accounting for internalization of role conception. The problem of internalization is reviewed and explored with particular reference to the "bureaucratic personality." Conditions for internalization are suggested.

A model for a sociological theory of motivation is proposed, consisting of these concepts: internalization, indeterminacy of self, self-deprivation, conflict and disillusionment. It is suggested that motivation be viewed as a product of efforts to define, validate, and fulfill a self-conception. Microfilm \$5.70; Xerox \$20.30. 448 pages.

**SOCIO-ECONOMIC STATUS, LEVEL OF ASPIRATION,  
AND JUVENILE DELINQUENCY.**

(L. C. Card No. Mic 60-1513)

Edgar Gustavus Epps, Ph.D.  
Washington State University, 1959

Supervisor: Dr. Joel B. Montague, Jr.

This study is an investigation of Merton's theory of delinquent behavior. According to this theory, juvenile delinquency results, in part, from the disparity existent in our culture between a culturally prescribed and emphasized common "success" goal for the population at large and restrictions for a large part of the population in obtaining access to this goal. Lower status persons are, therefore, said to be subjected to the greatest pressure toward delinquency.

The sample used in this study included 351 juniors in a Seattle high school. Data are based on the responses of these students to questionnaires administered in the spring of 1958. An occupational prestige scale was used as the tool for measuring socio-economic status and occupational aspiration. A Guttman-type scale was used for measuring juvenile delinquency. Educational aspiration was determined by asking students how far they expected to go in school. Chi-square and the coefficient of disproportionality were the principal statistical techniques used as aids in testing hypotheses in this study.

The following general hypotheses were tested: (1) There is no significant difference in the incidence of delinquent behavior by race; (2) there is no significant difference in the incidence of delinquent behavior by socio-economic status; (3) there is no significant difference in aspiration level by socio-economic status or by race; (4) there is no significant difference in delinquent behavior by level of aspiration.

Findings which were interpreted as non-supportive of Merton's theory were: (1) For the sample as a whole and for boys, lower status students were not more involved in delinquent behavior than higher status students; (2) Negroes were not significantly more delinquent than whites; (3) occupational and educational aspirations of high status students were significantly higher than those of lower status students; (4) occupational and educational aspirations of Negroes were significantly lower than those of white and Oriental students; (5) students with high occupational aspirations did not differ significantly in delinquent behavior from those with low aspirations; (6) students with high educational aspirations were significantly less involved in delinquent behavior than those who reported low educational aspirations.

Findings of this study which supported Merton's theory were: (1) Lower status girls were more involved in delinquent behavior than higher status girls; (2) Negroes were more involved in delinquent behavior than whites and Orientals; (3) large proportions of students from all socio-economic levels and from all racial groups reported high occupational and educational aspirations.

The data of this study are, in most instances, not in support of Merton's theory of deviant behavior. Some of the findings are, however, in agreement with the positions of other writers. Results of this study are similar to those of Nye and Short in a previous study of socio-economic status and delinquent behavior. Cohen's theoretical position

is supported by the finding that students who have high educational aspirations are less delinquent than those who have low levels of educational aspiration.

The results of this study seem to imply that theories of delinquent behavior based upon assumptions concerning the socio-economic distribution of delinquency are in need of revision or clarification. It may be concluded that the present study provides indications that further research is needed for a definitive evaluation of Merton's theory, but that the findings of this study suggest some revision or restatement of this theory may be necessary.

Microfilm \$2.50; Xerox \$5.00. 99 pages.

**MUSICAL AND SOCIAL PATTERNS OF SONGWRITERS:  
AN EXPLORATORY SOCIOLOGICAL STUDY.**

(L. C. Card No. Mic 60-4983)

Klaus Peter Etzkorn, Ph.D.  
Princeton University, 1959

This study presents a social-structural description and partial analysis of the songwriting occupation. In its second part it seeks to answer certain problems concerning the adequacy of social-structural explanations for questions of musical form.

Part one fills a gap of sociological knowledge concerning this occupation. Songwriting as an occupation affects much of our daily lives through its "work product," the popular songs. The manifold implications of popular songs for students of mass culture and for aesthetic theorizing, however, are not discussed in this study. It presents a description and analysis of the social relationships which are characteristic of the occupational milieu of songwriters, of the demographic and sociological characteristics of a sample of successful members of the occupation, and of their work commitment and musical values. In short, the first part of the study is designed as an addition to the catalog of sociologically studied occupational groups.

In the second part of the study the major emphasis is directed at the discovery of satisfactory explanations for the musical-structural rigidity of popular music. Studies by Blaukopf, Honigsheim, Meyer, Schering, Serauky, Silbermann, Simmel, Sorokin and Weber are examined for suitable leads and propositions. Neither propositions concerning the analytic independence of cultural systems from social action systems nor the traditional sociology of knowledge approach appear as tenable explanations. The particular socialization processes of songwriters seem, rather, to offer a more fruitful approach.

For tentative support, data culled from the literature and from hearings before Congressional investigation committees are supplemented with interview and questionnaire results of successful songwriters of 1958. The latter are defined as those writers who had at least one song during 1958 which sold one million and more recordings on one record label. There are forty-seven songs which meet this criterion for 1958.

Twenty-five usable interview and questionnaire returns were obtained from this population. The sheet music of forty of these songs is analyzed in terms of standard ethnomusicological categories and contrasted with compositions of contemporary serious composers. Results of



Dennison Nash's study of twenty-three American composers are contrasted with the data from the twenty-five successful songwriters.

It is tentatively shown that the particular cultural or musical value system of popular songwriters seems to be relatively independent of the economic structure of the popular music business. It is also shown that the differences in the socialization experiences of serious composers and songwriters seem to provide tenable accounts of the respective composers' systems of musical expression. Microfilm \$4.50; Xerox \$15.75. 349 pages.

#### STEPS ON THE WAY TO A PSYCHIATRIC CLINIC

(L. C. Card No. Mic 60-3087)

Charles G. Kadushin, Ph.D.  
Columbia University, 1960

Social factors influencing steps on the way to the Religio-Psychiatric Clinic in New York City were examined by administering research questionnaires and interviews to 110 patients before their first clinical interview. In comparison to other licensed psychiatric clinics, this clinic draws a higher proportion of Protestants, and includes both ministers and psychiatrists on its treatment staff. Its patients' social class level tends to be above that typical of hospital clinics but below that of patients of psychoanalytic institutes. Unlike other clinics, patients tended to hear of this clinic through reading rather than through medical referrals.

Differing from casual decisions, seeking psychiatric help changes a person's self-image. Hence, separate sets of questions, partitioned into dimensions suggested by Lazarsfeld and Parsons, were asked for each stage of the decision: realization of a problem, reading, choice of different professional spheres and choice of individual practitioners.

Persons in this sample realized their problems in four ways: by being told by others that they were ill, by experiencing physical symptoms or marital difficulties, or merely by introspecting. Lower class persons were more likely to be told they had problems. White collar workers generally defined problems physically. The wealthy more frequently presented marital problems. Professionals tended to introspect. Even with social class taken into account, introspectors were most likely, the physical symptom and told by others types less likely, and the marital problem type least likely to be retained by the Clinic. The former had attitudes toward therapy and conceptions of their problems more in keeping with those of psychotherapists.

Lower class persons in this sample were as likely to read in search of help as were higher class persons. The former read to learn about mental illness since they were less likely to know anyone in therapy.

Most Clinic applicants had seen other professionals previously. Since choice of minister is particularistic, higher class persons, who are more likely to be church members, were more likely to have chosen ministerial counseling. Those who had gone to ministers before other professionals were better integrated into a church com-

munity and had enjoyed a more satisfactory experience with pastoral counseling. No one had had extended contact with a minister, however, and few had seen more than one.

White collar workers frequently had chosen non-psychiatrist physicians. When chosen, physicians were first choice. They were usually chosen because a person thought he had physical symptoms. Lower class persons, those who saw their problems only in physical terms, persons whose self-image was reinforced by the prescription of medicine, and those less familiar with psychiatry tended to shop for more than one doctor. As a result, they tended to dislike doctors.

Lower class persons were more likely to have previously visited psychiatrists, perhaps because they were more likely to have failed in previous therapy. Personal influence was important in bringing persons to psychiatry. Those integrated into a community favorable to psychiatry more frequently had chosen psychiatric services before other professionals. They did less shopping for therapists. Ignorance of the type of problem to bring to a psychiatrist, the difficulty of finding one and a poor match between expected and received treatment all attest to a low institutionalization of psychiatry as compared to general medicine and to pastoral counseling.

Paradoxically, these professionals failed when they acted in a manner characteristic of their profession. Ministers, who develop friendly relations with parishoners, cannot engage in long-term counseling. Physicians are taught the use of medicines, yet prescriptions did not help these patients. Outpatient psychiatric services, trained to remain affectively neutral, are successful with the less ill. Many patients, however, did not understand the nature of psychiatric treatment. In addition, some were quite ill. Both the actual social structure and the mentally ill persons' perceptions of it affect their attempts to remedy their condition.

Microfilm \$5.90; Xerox \$20.95. 464 pages.

#### THE IMPACT OF THE UNIVERSITY EXPERIENCE UPON STUDENTS' WILLINGNESS TO ACCEPT THE ADVICE AND OPINIONS OF EXPERTS

(L. C. Card No. Mic 60-4215)

Paul LaBonte Sites, Ph.D.  
Purdue University, 1960

Major Professor: Robert L. Eichhorn

This thesis was concerned with the impact of the university experience upon students' willingness to allow experts a voice in the formulation of social policy and their willingness to accept the advice of experts in the solution of personal and family problems.

The study employed a cross-sectional survey design and was conducted at Purdue University, a large land-grant institution in Indiana. Data were gathered from a random sample of students at different class levels within the various schools of the University (May, 1959) and from students just entering the University (September, 1959).

Two Guttman Scales served as the dependent variables of the study: One measured students' willingness to allow

experts a voice in the formulation of social policy and the other measured students' willingness to accept the advice of experts in the solution of family problems.

Three groups of entering freshmen (Catholics, students from the lower social classes and students from the farm) were found to be less willing than others to accept the advice and opinions of experts. College students with these same background characteristics were used in testing the hypotheses on the assumption that these students were unwilling to accept the advice and opinions of experts when they enter the University as freshmen.

Comparisons made between entering freshmen and seniors revealed that the university experience does have a positive impact upon students' willingness to accept the opinions of experts in social areas and the advice of experts in the solution of family problems. Academic performance was found to account for more of this impact than any other single factor considered. A significant positive relationship was found to exist between students' grades and their willingness to accept experts. The mastery of materials in certain social science courses was also found to influence students' acceptance of experts.

A close association with former primary groups, who tended to reject experts, inhibited students' acceptance of experts in social institutions. This factor had no effect upon students' acceptance of family experts, however. On the other hand, high religious orthodoxy was found to be associated with a rejection of family experts, while having no relationship to the acceptance of experts' opinions in social institutions.

Students most willing to accept experts' advice in the solution of family problems contacted "campus experts" more often and had higher regard for their advice than did students less willing to accept the advice of experts in the solution of family problems. These students tended to turn to parents, friends, and religious agencies more for advice and rated their advice more highly.

Some evidence was found that instructors, high school teachers, ministers, and the mass media may have influenced students' acceptance of trained experts; while parents and the mass media may have exerted an influence upon students to accept "popular" experts. In general, the majority of college students studied indicated a willingness to accept the advice and opinions of trained experts in most social and family areas. The chief exceptions to this were in areas of religion, policies concerning racial integration, the national defense program, marital problems, and problems of mate selection. Very few students indicated a willingness to accept the advice of "popular" experts.

Microfilm \$2.50; Xerox \$8.00. 174 pages.

## SOCIOLOGY, PUBLIC WELFARE

### FLOOD CONTROL DAM PREFERENCE: A STUDY IN THREE COMMUNITIES OF THE CONNECTICUT RIVER VALLEY.

(L. C. Card No. Mic 59-1203)

Faith Harriet Sawyer Moore, D.S.S.  
Syracuse University, 1958

This report is a study of attitudes towards flood control dams in three areas of the Connecticut River Valley where flood control projects have been approved by Congress during the past two and a half decades.

The primary purpose of this study is to test the hypothesis that:

The preference for a multi-purpose dam exceeds the preference for a single purpose dam, a series of small dams, or a higher dam on an existing reservoir.

Each area was divided into regions and a random sample poll taken in each region. Among the important variables investigated in connection with dam preferences were attitudes towards more public beaches, a public dock, more picnic areas, more camping sites, more summer camps for children, and cemetery removal.

The report contains seventy-one frequency tables from data collected in each of the nine regions where applicable and nine maps taken from the New England-New York Inter-agency Committee Report on the Connecticut River Valley and other unpublished sources.

Investigation brought forth the following results:

#### AREA A: GAYSVILLE, VERMONT ----- WHITE RIVER VALLEY

1. Gaysville region: Preference for a multi-purpose dam exceeds preference for a single purpose dam.
2. Outside Gaysville region: Preference for a multi-purpose dam exceeds preference for a single purpose dam.

#### AREA B: WEST CANAAN, NEW HAMPSHIRE --- MASCOMA RIVER VALLEY

3. Canaan region: Preference for a multi-purpose dam exceeds preference for a single purpose dam or a higher dam on an existing reservoir.
4. Endfield region: Fail to reject null hypothesis on all three counts.
5. Lebanon region: Preference for a multi-purpose dam exceeds preference for a single purpose dam, a series of small dams, or a higher dam on an existing reservoir.

#### AREA C: LITTLEVILLE, MASSACHUSETTS --- WESTFIELD RIVER VALLEY

6. Littleville region: Fail to reject null hypothesis on both counts.
7. Chester region: Preference for a multi-purpose



dam exceeds preference for a single purpose dam or a series of small dams.

8. Huntington-Russell region: Preference for a multi-purpose dam exceeds preference for a series of small dams.
9. Westfield region: Preference for a multi-purpose dam exceeds preference for a series of small dams.

The poll covered 407 households in the three areas. It was executed in July and August of 1956.

Microfilm \$4.00; Xerox \$14.20. 312 pages.

## SOCIOLOGY, RACE QUESTION

### A STUDY OF FAULKNER'S PRESENTATION OF SOME PROBLEMS THAT RELATE TO NEGROES

(L. C. Card No. Mic 60-3118)

Agnes Louise Moreland, Ph.D.  
Columbia University, 1960

A second listing. Please see page No. 1192.

Microfilm \$3.25; Xerox \$11.25. 250 pages.

### AMERICAN SOCIAL SCIENTISTS AND RACE THEORY: 1890-1915.

(L. C. Card No. Mic 60-3698)

George Ward Stocking, Jr., Ph.D.  
University of Pennsylvania, 1960

Supervisor: Dr. T. C. Cochran

Modern social science does not in general accept the idea that social or cultural phenomena are in any way the product of innate differences in the mental makeup of the races of man. By an analysis of the relevant content of twenty scholarly journals published in the United States between 1890 and 1915, this dissertation investigates the sources of the modern social scientific position on race. The analysis is not carried out in quantitative terms. Nevertheless, the method of the study, and the sample upon which it is based (552 articles by 228 writers), are such as to distinguish it somewhat from the usual study in intellectual history.

The results of the study indicate that in 1890 the word "race" (or "racial") was employed by social scientists to designate a variety of human groups---racial, linguistic, religious, national, and cultural--- and to refer to various presumably hereditary characteristics of a broadly socio-biological nature, in terms of which these groups were frequently ranked in some sort of evolutionary hierarchy.

The separation of the various elements of this catchall concept was largely the work of anthropology, which tradi-

tionally had employed linguistic, cultural, and physical criteria for the classification of mankind. In the last half of the 19th century, anthropologists came more and more to realize that a classification based on any one of these criteria did not give the same results as one based on either of the others, and the term race was gradually reserved more and more for purely physical groupings.

After 1890, parallel developments took place in the biological and social sciences clarifying the concept of heredity. The emergence of modern genetics clarified the physical process of heredity, and a shift in orientation in the social sciences from the evolution of social structures to the study of historical and contemporaneous social processes led to the clarification of what was called by some writers "social heredity." This process was facilitated by the rejection in biology of the Lamarckian concept of the inheritance of acquired characteristics, which had been the implicit theoretical basis for the confusion of the racial and the cultural, the physical and the social, in matters of heredity.

The most important contribution to the clarification of the race concept, however, was that of anthropology. The careful anthropological study of racial differences revealed that they were overlapping and quantitative, rather than discontinuous and qualitative. The rejection of a unilinear sequence of cultural evolution and the explanation of cultural differences in terms of differing historical experience undercut one of the major props for theories of racial hierarchy, which were based on the assumption that the stages of this single sequence (represented in the modern world by the dark-skinned "savage" and "barbarous" "races") corresponded to the stages in the mental evolution of mankind. The concept of cultural determinism provided an alternative explanation for the obvious mental differences between human groups. And as the concept of cultural determinism was more systematically formulated in terms of the autonomy of the cultural level of phenomena, it in fact required the assumption that all human groups were equally capable of participating in human culture. A final consequence of the attack on the unilinear evolutionary concept of culture and the development of the concept of cultural determinism was the idea of cultural relativism, which further undermined theories of racial superiority, since they were ultimately based on assumptions of cultural superiority.

By 1915, as the result of the work of Franz Boas and his students in anthropology, the basis for the modern social scientific position on race had been laid.

Microfilm \$9.10; Xerox \$32.35. 718 pages.

### PATTERNS IN NEGRO-WHITE DIFFERENTIAL MORTALITY, 1930-1956.

(L. C. Card No. Mic 60-3618)

Richard Finn Tomasson, Ph.D.  
University of Pennsylvania, 1960

Supervisor: Dorothy Swaine Thomas

The main concerns of this study are two: (1) to determine the extent and characteristics of the generally downward trends in Negro male and female mortality

relative to that for white males and females, and (2) to compare age-adjusted and age-specific mortality trends for these four sex-race populations for 22 specific causes of death over this 27-year period.

Published and unpublished data from the U.S. National Office of Vital Statistics provide the chief source of data. These are supplemented with the data accumulated for the Industrial policyholders of the Metropolitan Life Insurance Company. Both these sources are evaluated in some detail. Mortality from all causes is discussed in terms of crude, age-adjusted, and age-specific rates; average life expectancies; infant and maternal death rates; and state, regional, rural-urban, and socioeconomic variations. The remaining two-thirds of the study is devoted to an analysis of specific-cause differential mortality.

Among the more important findings and conclusions of this research are the following:

- (1) The Metropolitan data can be a valuable aid in interpreting the official mortality data, besides being an index of the mortality experience of the urban, industrial segment of the white and Negro populations.
- (2) Over-all male and female Negro mortality has been declining at a consistently more rapid rate than that of white males and females since the early 1930's. This is not, however, generally the case for middle-aged and older females where white rates have declined more rapidly.
- (3) The best interpretation of the lower Negro death rates and greater life expectancies at the upper ages in the official data is that they are the result of overstatements of age in censuses among Negroes, together with the underreporting of Negro deaths among the old.
- (4) A curious pattern in the decline of nonwhite death rates was discovered for the period 1925-1955. In the first half of each intercensal decade in this period (1930-35, 1940-45, and 1950-55), there is greater percentage decline in nonwhite than of white age-adjusted rates. In the second half of each such intercensal decade (1925-30, 1935-40, and 1945-50), however, just the opposite situation prevails: greater percentage decline of white than of nonwhite rates. There is no exception to this pattern for either males or females. The same phenomenon characterizes the decline in age-specific rates after 1930. That this pattern is a function of nonwhite mortality decline is indicated by the much greater fluctuation in nonwhite than in white declines. Explanation of this is made in terms of systematic biases in intercensal estimates of the non-white population.
- (5) Positive statistically significant correlations between state age-adjusted death rates and median income and percent urban are found for white males and females, but no correlations are found for nonwhite males and females.
- (6) Changes in the nomenclature and classification procedures introduced by each revision of the International List of Causes of Death have had a differential impact on the varying age, sex, color, and geographic categories making long-term differential mortality analysis for the specific causes of death difficult.
- (7) Because of the lessening of differences in living standards between whites and Negroes in recent years, a shrinking of mortality differentials might be expected. While this is true of over-all mortality, it is not true of all major causes of death, for example, hypertension, nephritis, accidents, and homicide.
- (8) Trends and patterns of Negro-white differential

mortality from some specific causes of death, most notably heart disease and malignant neoplasms, are misrepresented by vital statistics data because of differential diagnoses. Microfilm \$5.10; Xerox \$18.00. 398 pages.

#### SOCIOLOGY, SOCIALISM, COMMUNISM, ANARCHISM

##### A PACIFIST COMMUNITY IN PEACETIME: AN INTRODUCTORY DESCRIPTION OF THE WOODCREST BRUDERHOF AT RIFTON, NEW YORK.

(L. C. Card No. Mic 59-1208)

David Stanley Tillson, D.S.S.  
Syracuse University, 1958

This dissertation is a community study based on 49 days of field work, involving "limited participant observation," and upon relevant historical documents.

One of nine religious communities composing the Society of Brothers which was founded in 1920 in Germany by Eberhard Arnold, the Woodcrest "Bruderhof" at Rifton, New York is an "intentional" fellowship -- monogamous, pacifist, communist, and Christian. Founded in June 1954 by six missionaries from the Paraguayan "bruderhoefe" and by converts from small American intentional communities, Woodcrest has grown rapidly to 190 persons: 70 members and novices, 105 children, and "guests." Members are German or American and include several families from Forest River, North Dakota, a Hutterite community converted to the "Bruderhof" in 1955. Including numerous ex-social workers and ex-ministerial students, the American majority is largely middle class, college educated, and Protestant -- mainly, formerly of Friends or Church of the Brethren persuasion. Membership is a life commitment surpassing in seriousness even the marital tie. As needed, members and novices are transferred from one "hof" to another. During his novitiate the prospective member examines himself; he does not participate in community government.

The Brotherhood, the assembly of full members, meets several evenings each week and governs by unanimous decision, as led by "the Spirit." A number of committees -- Morning Meeting, Shop Management, Building, Kitchen -- bear particular, subordinate responsibilities; the School committee directs eight grades of primary education on the premises. The Steward husbands the common purse; the Housemother allots clothing and looks after birthdays; the Storekeeper buys all the food; there are also two work distributors. The Servant of the Word is the personal counsellor and the spiritual leader of the community.

The "Bruderhof" maintains a Christocentric, Pentecostal, yet ethically perfectionist outlook. This requires the "pure witness" of the Sermon on the Mount in order to attract the world to a "City Set on a Hill" and convert it to God; Woodcrest maintains an Open Door to receive anyone who is "truly seeking." The major religious service is the semi-weekly "Gemeindestunde" or prayer meeting; admission is denied anyone "who has anything against his brother." Mutual admonition is said to preserve communal unity.



The "Bruderhof" does not accept the validity of sacraments. Baptism is a "symbol"; the Bible is a "guide" for the workings of the Spirit. Love Meals are ceremonial occasions considered symbolic of unity; communion is held annually at Easter.

Meals are taken in common, with reading while eating and singing often afterwards. Breakfasts and Wednesday and Sunday evening meals are eaten in family apartments. Each family is allotted several rooms, primarily for sleeping. No special dress or adherence to rigid rules characterizes members of the "Bruderhof." Moderate smoking is seen often; the only sumptuary taboo, apparently, is modern dancing.

Woodcrest's low but increasing income comes from gifts and, mainly, from "Community Playthings," the woodshop, which produces Blocks and other educational toys. Other work departments include Kitchen, Laundry, Sewing room, ten acres of vegetable farm. The Building crew has erected three substantial apartment houses and a community center since 1955.

Prospects favor continued growth of the movement. There is an absence of irrationalities and eccentricities; the average age of members and novices is only 36.

Microfilm \$4.75; Xerox \$16.90. 371 pages.

## SPEECH-THEATER

### THE PHONOLOGICAL PROBLEMS INVOLVED IN IMPROVING THE ORAL ENGLISH OF ILOKO SPEAKERS

(L. C. Card No. Mic 60-3408)

Nobleza Castro Asuncion, Ph.D.  
Michigan State University, 1960

Major Professor: Frederick G. Alexander

The purpose of this study was to examine the problems involved in improving the oral English of educated Iloko speakers.

A linguistic analysis of Iloko phonology was made to determine the elements of the sound system. Four informants were used, three recorded material on tape and the fourth provided the face-to-face contact for analysis with the analyst who also speaks Iloko as her native tongue.

A linguistic analysis of middle-western American English phonology was obtained and an item by item contrastive analysis was made between the two languages. The segmental and suprasegmental phonemes were examined and compared on points of articulation, distribution, arrangement and rhythm.

The comparison showed that there were English sounds not present in Iloko. Since they would be unfamiliar to the Iloko speaker, they would find them difficult to master. The predicted difficult sounds were: [p' t' k'] /c j f v θ ð z š ž æ ɔ oy ow/.

The predictions were verified by obtaining samples of English speech of Iloko speakers. The speech situations were divided into two groups: I and II. Group I was the formal situation (scripts were provided the subjects a few minutes before recording time), and Group II was the informal situation, unrehearsed and no scripts provided. Cuts were made of the taped corpus and Group I comprised four Iloko speakers. Group II comprised six speakers. The former was analyzed by two professional speech correctionists, one of them, also an audiologist; and a general speech and language teacher. The latter was analyzed by five advanced speech correction majors. They all spoke middle-western American English.

They were asked to listen to the Ilocanos speaking in English on tape and were provided with scripts where they

would write the "error" above the indicated sound. The standard speech upon which they based their judgements was their concept of the speech of an educated middle-western American speaker. They were asked to judge on intelligibility and on how close the utterance came to the standard speech.

A total of sixteen sounds were predicted to be difficult. Results proved the prediction. The sounds were then ranked according to percentage of difficulty in initial, medial and final positions. The ranking was made on intervals of 20 - from least difficult, not quite as difficult, difficult, very difficult, most difficult, from 0 percent to 100 percent respectively.

The implications of this study are:

1. In teaching speech improvement to educated Ilocanos, there should be more emphasis on the problematical sounds (those not present in Iloko phonology) and less time spent on teaching the "easy" sounds (Iloko sounds which are phonetically similar, in a rough way, to English),
2. The curriculum maker should revise existing courses of study to meet the needs of the students and make the results of this analysis and others similar to it as his guides in preparing new materials.
3. New methods suggested by speech and linguistic science should be made the core of instruction.

Microfilm \$2.50; Xerox \$6.60. 138 pages.

THE REPRESENTATION OF THE IMMIGRANT  
ON THE NEW YORK STAGE - 1881 to 1910.

(L. C. Card No. Mic 60-3738)

Robert Merritt Dell, Ph.D.  
New York University, 1960

Chairman: Professor John C. McCabe

The purpose of this study was to investigate possible relationships between the arrival in America of three immigrant groups and the emergence of each group in American plays professionally produced in New York City between 1881 and 1910.

The principal aim was to determine how German, Irish and Italian immigrants were represented by playwrights whose works were produced during this same period and to indicate whether such characterizations coincided with the social and economic status of those immigrants as reported by standard authorities.

Existing immigration statistics for the thirty years were recorded by decades rather than by individual years. The decade 1881-1890 marked the high point in German immigration (1,452,970 persons). The following decade brought the last great wave of Irish immigration to America (655,482 persons). During the final ten-year period, the hordes of Italian immigrants outnumbered the German and Irish as Italy reached first place on the statistical listings of the United States Immigration and Naturalization Service (2,045,877 persons). The years from 1881 to 1910 represent the largest surge of immigrants of these three groups.

The drama has always aptly reflected the way of life and culture of the nation which produced it. The waves of immigration and the consequent settling of individual immigrant groups were treated by writers of the period, and the playwright was no exception. Although practically all American playwrights of the era made little attempt to reach beyond the realm of sheer entertainment in their plays, they mirrored the American scene as it appeared to them and the immigrant was a part of that scene.

Of some two hundred plays containing German, Irish and Italian immigrant characters, only eighty-four were located in published editions or manuscript form. Secondary sources yielded pertinent information about thirty more. These plays indicated that immigrant characters were often depicted in humorous and unflattering lights. Separate immigrant groups became stereotyped according to traits and characteristics attributed to them by playwrights who emphasized their mode of dress, manner of speech, and dominant physical and emotional attributes.

German roles were limited primarily to melodramas and comedies. The stage German usually appeared as a home-loving, hard-working, ambitious, honest, and thrifty person. Inclined toward stubbornness and slow to change his mind, he usually attacked a problem with methodical orderliness. Stage Germans grew progressively through the three decades and playwrights did not compartmentalize them by attaching them to specific occupations or stations in life.

Unlike the stage German, the stage Irishman was discovered in a variety of roles, some of which were definite stereotypes. Certain nationalistic characteristics of the Irish were manifested in stage roles, chiefly in melodrama and comedies which generally pictured them as honest

individuals given to vehemence and argumentativeness when provoked. Such characteristics as emotional outbursts etched with brogue and bluster, humor, sentimentality, imaginativeness, and lyrical expressions of thought were omnipresent.

Representations of stage Italians fall antithetically between benevolent street vendors and villainous henchmen in melodramas and comedies. The characterizations were based upon a volatile Latin temperament which found expression in song, laughter, and in lively emotional discussions conducted in broken English.

Emigration has resulted in a time of conflict, and following the gradual process of assimilation these immigrants eventually amalgamated with the population. Their subsequent depiction on the New York stage changed from derogatory representation to one which became more benevolent, more admirable, and more heroic.

A future study which would trace the representation of these three immigrant groups since 1910 would undoubtedly be a worthwhile undertaking.

Microfilm \$3.85; Xerox \$13.50. 300 pages.

THE MODIFICATION OF SPEECH SOUNDS BY  
ALTERATION OF THE AIR-BORNE  
AUDITORY FEEDBACK

(L. C. Card No. Mic 60-4750)

Gene England, Ph.D.  
Northwestern University, 1960

The present study was undertaken in order to demonstrate experimentally the reported occurrence of a clinical phenomenon observed among functional articulatory defectives. This observation was that these individuals modified their misarticulated speech sound productions as a result of introducing to their ears a correctly articulated speech sound at masking intensity. Normal speaking subjects were selected in order to provide useful data on a presumably fundamental process.

Twenty-five subjects, five in each of the ages nine through thirteen years, were selected at random. The subjects were required to have normal speech and hearing and to have had no prior speech correction. They were asked to maintain productions of certain phonemes for periods of six seconds at constant levels of intensity. The randomized sequence of superimposing sounds which masked the subjects' feedback consisted of "pitch-wobbled" samples of other phonemes and a sample of sawtooth noise. They also produced their phonemes without introduction of other sound. This served as a basis of comparison for phoneme stability.

The experimental apparatus enabled variations of the methods of feedback alterations, i.e., binaural, monaural, and alternate-monaural presentations of the superimposing sounds and the subjects' own sound productions. The equipment also enabled the control of gradual amplification or attenuation in each ear and permitted sufficient differences in intensity between signals presented to the earphones to mask the subjects' feedback of their sound productions.

A panel of three judges listened to early and later segments of the subjects' productions to determine presence



of shifts from one phoneme to another during each attempt. The productions judged to have shifted were then transcribed allophonically by a different judge.

The data indicated that the superimposition of certain phonemes was significantly more effective in modifying other similar phoneme productions than the introduction of noise at masking intensity. Particular phonemes seemed to have more effect than others on the basis of the limited number utilized in this study. In those cases in whom modification occurred, the changes were nearly always in the direction of the speech sounds superimposed. There were no significant differences in effect noted among the three methods of feedback alteration. There were no differences in numbers of phonemic modifications among subjects relative to age or sex. There was marked variability among subjects as to frequency of phonemic modification. Microfilm \$2.50; Xerox \$4.60. 90 pages.

#### PRINCIPLES FOR DESIGNING THE HIGH SCHOOL AUDITORIUM

(L. C. Card No. Mic 60-3742)

Leslie Howard Fox, Ph.D.  
New York University, 1960

Supervisor: Assistant Professor John McCabe

The aim of the investigation was to determine valid principles to guide the planning of a high school auditorium. There were three basic steps: to determine intrinsic aims and implementing activities of secondary education, to discover which activities have particular need for an auditorium, and to develop principles for auditorium design to meet the physical needs of these auditorium activities.

A five-page questionnaire on auditorium recommendations was sent to selected architects, school administrators, and teacher-users of auditoriums. Over three hundred authoritative books and articles on school plant planning, theaters, and technical theater were consulted. Additional recommendations were secured through interviews with theater planning experts.

Most high school auditoriums are unsatisfactory for some or many of the activities which they should house; this was discovered from statements by planners, by users, and by experienced theater and music personnel. The auditorium does, however, possess unique educational potentials. Respondents said unanimously that an auditorium is desirable; eighty-six percent said that it is necessary to a complete high school program. It should be designed for most efficient functioning.

The investigation found that planning should provide for music, dramatics, and assembly activities and for use by both school and community.

Analyses involved four aspects: performer-audience relationships, performance requirements, preparation areas, and ancillary audience areas. Each analysis explored the physical needs of the activities and gathered practical recommendations. A series of principles followed each analysis. The total range of principles was gathered into a final essay on the design of the high school auditorium.

Optimum hearing and seeing conditions were found to

be of prime importance: capacity should not be excessive; seating should provide clear sight lines; ceiling and side walls must be expertly planned as sound reflectors for uniformity of sound reception throughout the room (electronic reinforcement should not be necessary). Both the traditional proscenium arch and the platform stage projecting towards the audience have merit; the choice should be based upon the expected demands of a particular auditorium and the skill of its staff.

Space is the most important element for a stage. It should be at least as deep and twice as wide as its opening. Either adequate height for rigging should be provided or the stage width should be increased.

Contiguous work and storage areas are highly desirable. Dressing and costume work spaces may be combined with music or speech practice rooms and with homemaking laboratories; scenery building needs considerable space, preferably separate. Stage lighting provisions, which can be the most valuable technical aids to auditorium use, should receive most careful planning.

Lobby and foyer areas can be so designed as to meet other school needs as well, thus increasing the usefulness of these otherwise seldom used areas. The auditorium complex should be separable from the remainder of the school when used alone, and should have outside access for both audience and backstage personnel. A high school auditorium should be a separate room; no combination is satisfactory, the auditorium-gymnasium least of all.

The investigation has established that the auditorium can make a valuable and unique contribution to a modern high school program. For the creation of an efficient multi-use auditorium unit which permits realization of its full educational potential, sound planning based upon valid principles is obligatory. It is hoped that assistance to that end may be available through the results of this investigation. Microfilm \$4.70; Xerox \$16.45. 365 pages.

#### SCREENING TESTS OF HEARING: AN INVESTIGATION OF THE RELATIVE VALUE OF FOUR SCREENING TESTS OF HEARING IN DETECTING HEARING IMPAIRMENT.

(L. C. Card No. Mic 60-3743)

George Harris Friedlander, Ph.D.  
New York University, 1960

Chairman: Professor Dorothy Mulgrave

The detection of any impairment of function of children is of great importance to the child, the parents, and the community. The early detection of hearing impairment in children enables the parent and the community to institute appropriate medical, educational, and psychological procedures so as to insure the maximum development of the potentialities of each child. Studies of hearing loss in school children disclose that about five per cent of our school population have a hearing impairment requiring medical follow-up and/or special educational training. On the basis of present census figures, more than two million school children have impaired hearing.

The purpose of this study was to evaluate the capacities of four types of screening tests in detecting impairment in

the hearing of children at fifteen decibels. For this study 305 female students in the eleventh year of school were tested, under quiet room conditions, with four screening tests, a pure tone individual screening test, a 4C phonograph audiometer test, a pure tone group screening test for forty subjects known as the Massachusetts Test, and a pure tone group screening test for ten subjects, known as the Johnston Test. All ears found impaired by the criteria established for each test were given an individual pure tone threshold test. In addition, a matched control group of ears found unimpaired by the screening tests were also given an individual pure tone threshold test to determine whether any impaired ears had remained undetected by all four screening tests. A questionnaire answered by eighteen leading audiologists resulted in the development of a scale of values of such items as portability, cost, ease in setting up the test, ease in administering and scoring, time required to test each student, and time required to train personnel to conduct the test.

The results indicated that the individual screening test alone shows good discrimination when compared with a pure tone threshold test. The individual pure tone screening test differs significantly from the other screening tests in the ability to discriminate between impaired and unimpaired ears, and in ability to estimate impairment correctly. This test alone makes significantly fewer errors in identifying impairment in impaired ears.

The conclusions derived from the data involved in the questionnaire are that the equipment involved in the individual screening test is most portable, least costly and the simplest to set up and put away. There was a wide variation in time involved in administering the tests. With the Massachusetts Test, 600 subjects could be tested in a normal day as compared with 260 subjects with the 4C phonograph audiometer and the Johnston Test, and about 200 with the individual pure tone screening test. In view of the fact that a training program of about fifteen hours enables each of the trainees without previous hearing testing experience to conduct each of the tests according to the manuals of instruction, assures any school facility of an ample reservoir of potential testers from the community or staff of the school.

Because of the statistically significant differences between the individual screening test and the other screening tests used in this study, it is recommended that this test be used and testers trained in each school to administer the test. Microfilm \$2.50; Xerox \$6.60. 139 pages.

**COLORADO MOUNTAIN THEATRE: HISTORY OF  
THEATRE AT CENTRAL CITY, 1859-1885.  
(VOLUMES ONE AND TWO)**

(L. C. Card No. Mic 60-4086)

Jesse William Gern, Ph.D.  
The Ohio State University, 1960

The current prominence of Central City's annual revival of theatrical and operatic productions is of some consequence in the cultural status of the state of Colorado and the Rocky Mountain West. The present study was undertaken with the belief that an investigation of the theatre of Central City from its beginnings in 1859 to 1885

might shed some light on Central's unique position at the present time as well as contribute in modest measure to our knowledge of the latter nineteenth-century American theatre and in particular to the development of theatre along the western mineral frontier.

Infrequently do simultaneous accounts of the birth and growth of a theatre tradition and of a pioneer mining community present themselves to theatre researchers, but such is the case with regard to Central City. Remarkably complete files of Central's and Denver's newspapers became the basis of the preponderance of evidence used in this study. A listing of the dates, theatres, performers, and plays presented from 1859 to 1885 was gleaned from the newspapers. The study was then organized so that the geographic, economic, political, and social milieu could be determined in order that the theatre could be placed institutionally in the total perspective. The contributions of the actors, professional and amateur, to the growth of a theatre tradition were considered. In particular, the labors of Mr. and Mrs. John Langrishe, Mike Dougherty, and John Glendinen (a scene designer), along with various well-known nineteenth-century actors, were noted. The staging facilities and procedures were studied, and with the use of some selected promptbooks from the Ohio State University Theatre Collection, a method of production for certain "sensation" plays was inferred. The reactions of Central City's playgoers to their theatre were compared with reactions of playgoers in other parts of the United States.

In conclusion, the evidence showed that the present artistic success of Central City reflects the story of that mineral frontier theatre. The town and theatre progressed side by side, and there was a close relationship between the theatre as an institution and the community itself. The indigenous quality of Central's theatre tradition was an outgrowth of this relationship. More than eighty years later, those first twenty that went into the fashioning of an Opera House that exists to the present time seem to be of great importance. The Central City Opera House stands today as a monument to the indomitable spirit of the pioneers of Colorado's first important mining center and to the affection that they had for theatre.

Microfilm \$8.10; Xerox \$28.80. 638 pages.

**A COMPARATIVE STUDY OF TEACHER ATTITUDES  
TOWARD TEACHING BY  
CLOSED-CIRCUIT TELEVISION**

(L. C. Card No. Mic 60-3746)

Stanley D. Handleman, Ph.D.  
New York University, 1960

Supervisor: Professor Dorothy Mulgrave

The purpose of this study was to determine the comparative attitudes of two groups of college teachers toward the utilization of closed-circuit television in college and university teaching. The basic hypotheses under investigation were: (1) that a difference in over-all attitude toward the efficacy of television as a teaching medium existed between a group of teachers who had done direct teaching by closed-circuit television and a group of teachers



who had never taught by this medium, (2) that those teachers who taught by closed-circuit television had a favorable over-all attitude toward its efficacy as a teaching tool, (3) that those teachers who had never taught by television had an unfavorable over-all attitude toward its efficacy as a teaching tool, (4) that the strength of the favorable attitudes of the television teachers was positively related to the length of time that they were involved in television teaching, (5) that by investigating the several items individually, specific attitude patterns could be determined.

The experimental population consisted of two groups of college teachers from twenty-four colleges and universities representing the major geographical sections of the United States. These institutions all utilized closed-circuit television for purposes of direct teaching. One group consisted of eighty-seven teachers who had taught by closed-circuit; the other group of forty-nine teachers had never taught by television.

The technique used to determine the attitudes toward television of the two groups was a Likert-type attitude scale. Each respondent was asked to indicate his degree of opinion toward a number of statements relevant to the attitude under investigation by placing his response on a five point agreement - disagreement scale. The statements were validated by the use of a preliminary pilot study employing twenty percent of the available population. The final questionnaire contained forty statements which related to the use of closed-circuit television in colleges and universities for purposes of direct teaching.

Ten questionnaires containing a built-in attitude scale were sent to each of forty colleges and universities which utilized closed-circuit television. They were sent to the television coordinator in each school with a set of directions governing methods of distribution and matching. The teachers were to be matched according to age, sex, teaching experience, subject taught and specific personality traits. Twenty-four schools responded by returning completed questionnaires.

The results of the investigation indicated that a significant difference in attitude toward teaching by closed-circuit television existed between the two groups. Teachers who taught by television displayed a significantly more positive attitude than did the teachers who had never taught by television. Those teachers who had no experience in television teaching also displayed a significantly favorable attitude toward television teaching. In determining possible relationship between length of time in television teaching and strength of positive attitude, a significantly positive relationship was shown to exist.

It was determined that seventeen of the forty questionnaire statements significantly differentiated the two groups. These statements clustered about a number of attitude patterns that reflected specific areas of opposition on the part of the non-television teachers to certain aspects of television teaching. Among these was the fear of standardized, mechanized education, fear of reduction of importance of the non-television teacher, lack of teacher-student feedback, and a distrust of measuring instruments employed by researchers.

In this study an attempt was made to clarify the attitudes of teachers toward teaching by television. Although experiments indicate students learn by television, faculty acceptance is considered critical to the success of the medium in education.

Microfilm \$2.50; Xerox \$7.40. 158 pages.

## BINAURAL SUMMATION IN THE ELDERLY

(L. C. Card No. Mic 60-4787)

Jean Meredith Povinelli, Ph.D.  
Northwestern University, 1960

Adviser: Raymond Carhart

The purpose of the present study was to investigate whether binaural summation of auditory stimuli follows the same general pattern at threshold in the elderly as in young adults and, if not, whether binaural inhibition appears in the elderly.

Twenty young, normal-hearing adults and forty listeners over sixty, with varying degrees of auditory sensitivity, were given monaural and binaural hearing tests by air conduction at four frequencies, i.e., 250, 500, 1000 and 4000 cps. Binaural thresholds were obtained by two different methods. According to Method I, stimuli were presented at equal sound pressure level to the two ears, while according to Method II, the binaural stimuli were presented at equal sensation levels in the two ears. Subjects of the two sexes were equally distributed in both groups.

The criterion variable for all statistical analyses was binaural summation by Methods I and II. The amount of summation by each method was determined by taking the algebraic difference between the binaural thresholds and the better of the two monaural thresholds. The data obtained were analyzed to determine the effect of the following five variables on summation: age, method of stimulus presentation, sensitivity difference between ears, frequency of the stimulating tone and sex of the listener. The following findings and conclusions resulted.

1. Age. The average summation by Method II was 3.3 db for the control subjects and 2.6 db for the elderly subjects. Thus, the amount of summation obtained by the young and elderly listeners was essentially equivalent under conditions of matched sensitivity. Moreover, the results obtained on both age groups were in close agreement with the 3 db threshold summation reported by previous investigators, when the mean summation for the four frequencies was considered.

2. Method of Stimulus Presentation. The mean difference between binaural and better-ear monaural thresholds obtained on all sixty subjects was significantly larger at all frequencies by Method II than by Method I. The greatest discrepancy occurred at 250 cps, where mean summations were 4.3 db and 1.9 db, respectively.

3. Sensitivity Difference Between Ears. Difference in summation between subjects with less than 6 db mismatch and those with greater than 6 db mismatch were too small to reach a 1 percent level of statistical significance at 250, 500 and 4000 cps.

4. Frequency. The present data support previous findings relative to a decrease in the size of summation with an increase in the frequency of the stimulating tone. This trend is most pronounced in the Method II results where the mean summation was 4.3 db, 3.4 db, 2.0 db and 1.6 db at 250, 500, 1000 and 4000 cps, respectively.

5. Sex. No basic differences in the summational characteristics of the sexes were evidenced in the present experimental data.

### Conclusions.

Based on the data at hand, it appears that binaural summation in the elderly is not significantly different from

binaural summation in the young listener. The data obtained in this investigation offer no support for the hypothesis that binaural summation is abnormal in the hearing responses of the elderly. Therefore, Carhart's hypothesis, attributing poorer bone than air-conduction sensitivity at 500 cps in the aged listener to reduced binaural summation or to binaural inhibition, cannot be accepted.

#### Implications.

Three major implications emerge from the present investigation.

1. The 3 db value is a convenient approximation of threshold summation but fails to accurately reflect the variations in summation with frequency.
2. Future studies of summation should incorporate only the Method II procedure.
3. Either age has no adverse effect on the function of the central summing mechanism or whatever degenerative changes occur cannot be observed through a malfunctioning of the organism in its handling of binaural pure tone stimuli. Microfilm \$2.50; Xerox \$6.60. 136 pages.

#### REVIVALS ON THE NEW YORK STAGE, 1930-1950, WITH A STATISTICAL SURVEY OF THEIR PERFORMANCES FROM 1750-1950. (VOLUMES I AND II).

(L. C. Card No. Mic 60-4791)

Marie J. Robinson, Ph.D.  
Northwestern University, 1960

This study was undertaken in the hope of shedding some light on familiar questions concerning the causes of success or failure of certain kinds of productions on Broadway. The particular kind of production chosen for examination here is the "revival": a play originally produced at some time earlier than the instance under immediate consideration.

All revivals produced on Broadway between 1930 and 1950 were studied in detail. The number of performances attained by each was tallied and the various critical reviews of each production were compared. In addition a record was compiled covering all the performances of each play from its very first performance (in some instances, in 1750) through the year 1950.

A number of perennial questions have been considered, such as:

Is there any one factor in a revival production which can be used to estimate the probable degree of success?

Which possesses the greatest "draw": play-script, particular production, or principal performer?

Are revivals of great plays generally initiated by star performers?

Do reviewers tend to follow any discernible pattern in their treatment of revivals?

Does previous success influence the "draw" of revivals?

It was hoped that close study of both critical reviews

and performance records of a large number of revivals might provide partial answers at least to some of these questions. This hope has not been wholly unrealized.

The success of a revival depends upon play, cast and production, although these things are by no means equal in importance. Great plays seem to demand excellence of both acting and staging, while lesser plays may succeed with only one element outstanding.

The survey of productions starring such great performers as Cornell, Gielgud, Evans, and Hayes indicates that stars are often responsible for revivals, especially of classics. However, the presence or absence of a particular star does not always bring success or failure. Some plays succeed with the original star reappearing in the revival; others fail despite this advantage.

A summary of critical comments reveals that no consistent pattern is followed by all. Most consistent is Stark Young because of his insistence upon synthesis of production, performance and play-script.

When plays as well-known as Shakespeare's are revived, the general familiarity of the audience with the particular play is apparently significant, for the more familiar plays are also the most successful. In contrast, topical plays and mystery melodramas seem to suffer rather than gain from familiarity; the better known they are the less successful they are likely to be.

Statistically, the risk involved in producing revivals approximates that in producing original scripts. Of 374 revivals in 1930-1950 forty-six scored over 100 performances, fourteen achieved over 200, one exceeded 300 and one 400. The statistical record also reveals that classics and better dramatists have been more popular on Broadway than critical complaints have indicated. Twenty-six of the plays topping 100 and 200 showings were by such dramatists as Aristophanes, Chekhov, Euripides, Ibsen, Marlowe, O'Casey, Rostand, Shakespeare, and Shaw. Shakespeare heads the revival dramatists with twenty-three plays, Shaw follows with fourteen, Ibsen had nine, Barrie five, Chekhov, Coward, and O'Neill, four each. There was better reception and better quality in plays revived in the later years of 1930-1950. Generally the lighter plays were more popular.

The statistical record needs qualification, however, some revivals having been withdrawn for reasons other than lack of audience appeal.

Summarizing, few questions found definite answers. But evidently the more unusual or striking elements tend to lose appeal; the simpler, more human, more familiar to audiences stand the test of time and of revival. It is not surprising, therefore, that in revivals Shakespeare is the uncontested master.

Microfilm \$16.25; Xerox \$58.05. 1290 pages.



THE CHARACTERIZATION OF THE MALE  
PROTAGONIST IN SERIOUS AMERICAN DRAMA  
FROM 1920 TO 1940

(L. C. Card No. Mic 60-3834)

Webster Leroy Croxdale Smalley, Ph.D.  
Stanford University, 1960

The physical, emotional, and rational qualities of the heroes in serious American drama reflected the rapidly changing social and intellectual climate in America during the decades 1920-1940. Although plays lacked the profundity of other literary forms of the time, by 1925 American serious drama successfully dealt with contemporary social and intellectual problems. American drama of the twenties contained more heroines than heroes, but some notable male prototypes were introduced by O'Neill, Anderson and Stallings, and Howard. The male protagonist of the middle and late twenties was likely to be physically, intellectually, and morally imperfect. The majority of such protagonists lacked extensive formal education and belonged to the lower social classes.

Such writers as Arthur Richman, Lewis Beach, Zona Gale, and Elmer Rice attempted to popularize the "little man" as hero, but plays with bookkeeper heroes were not popular even when placed in a colorfully experimental play like *The Adding Machine*. Imperfections in a central character can be traced to the growing acceptance of new psychological and sociological concepts by playwrights and audiences. The use of these concepts as tools of characterization (except in the plays of O'Neill, Rice, and a handful of other playwrights of the twenties) was superficial. However, the typical dramatic hero of the twenties was emotionally rather than rationally motivated, was unconventional (particularly in regard to sexual morality), and tended to make pragmatic rather than absolute moral judgments. As a result, he was often somewhat unsympathetic, as in *The Emperor Jones*, or comic, as in *They Knew What They Wanted*.

The number of plays produced in New York dropped sharply after 1930, but the number of plays with male heroes increased. As serious American drama became more concerned with ethical problems, the character of the hero changed. The educational background and intellectual powers of the protagonist became greater. He was likely to be a college graduate--a doctor, lawyer, or a professor--and to be in an affluent position. The irrational remained an important aspect of character, but it was not dominant as a motivating force in the majority of plays. The tendency of serious plays of the thirties to express an intellectual idea or thesis brought to the fore the protagonist who could recognize and overcome emotional instability. A minority of successful plays contained a hero who was warped by environment. Such plays (*Dead End* and *The Criminal Code*, for example) inevitably condemned the environment.

From 1930 to 1934, the typical hero was concerned with questions of professional ethics; from 1934 to 1939, with social and economic questions; and from 1939 to America's entrance into the war, with the ethics of violence. The attitudes of the male protagonist changed rapidly during the thirties, particularly in regard to war. Typical were the changes in Robert Sherwood's heroes who displayed moral confusion in 1935, uncompromising pacifism in 1936, willingness to accept political responsibility in 1938, and justification for war against tyranny in 1940.

No qualities were found to be common to all male protagonists in either decade. However the qualities of selflessness, loyalty, taking action against evil, steadfastness of purpose, bravery, and capabilities for love and mercy are universal ideals of conduct. When any of these qualities are lacking in a character, this lack is recognized and he is pitied or condemned. A character, after 1920, however, could lack one or more of these qualities and retain audience sympathy. The totally virtuous hero did not disappear after 1920, but he appeared in fewer successful plays and when he did appear, he was more complex, even in his virtue, than his counterpart of before the first World War.

Microfilm \$7.95; Xerox \$28.15. 625 pages.

TWENTIETH CENTURY SCENE DESIGN - ITS  
HISTORY AND STYLISTIC ORIGINS

(L. C. Card No. Mic 60-3561)

James Robert Thompson, Ph.D.  
University of Minnesota, 1957

Adviser: Dr. Tselos

The purpose of this thesis is to determine if stage design, in the history of the theatre, should still be regarded as a thing apart from the history of art. Scenic design is approached in terms of its actual components of style - the formal elements of visual art and their interrelationships. A general overview of twentieth century stage design attempts to determine major style phases, their first appearance, their similarities to developments in other arts, their popularity, their spread, and the period of their decline.

The first chapter, *Painter Beginnings*, discovers that basic theories of modern design were formulated and put into practice by the designers of the Symbolist state. Design was related to play content in that it echoed the atmosphere or emotional essence of the play. The theory of unity of effort between theatre arts was practiced. The designers of the Symbolist stage were the Nabis painters; and while they reinforced qualities of the script, their formal equivalents or visual means came from painting.

The second chapter finds Art Nouveau scenic design primarily a modish style despite a brief period of curvilinear Art Nouveau expressionism in Germany. Frequently the actor was de-emphasized, and the adaptability of the style to all types of theatre production was limited. Acceptance of the style was a foregone conclusion since it was established in all arts before its appearance on the stage.

Chapter three examines the Neo-Rational style of design in which the designer aligned himself with developments in architecture. Consequently Neo-Rational designers - even though they used the style frontally and pictorially - found a new means of breaking from the past which various painter-illustrator aesthetics had dominated. The style, evolving directly from the work of Otto Wagner and the Vienna Secession, came to dominate the Austrian and German stages between 1902 and 1907. Subsequent designers around the world adopted it. Most important, Neo-Rationalism supplanted eclectic historicism and Belasco Realism in scenic design.

Of the many movements in twentieth century painting, chapter four finds only two making a pronounced effect on scenic design. The influence of Fauve art was very limited and confined to the second decade. More pronounced was Cubism's effect in the twenties.

Chapter five investigates the Space Stage, a logical development following the Neo-Rational style which was itself producing proto-space stages. The Space Stage utilized the first architectural conception of scenic design since the Baroque period. It offered the director free flowing, articulated space areas which provided a continuous environment for the various needs of a script. In all four kinds of Space Stages, the problem is one of organizing space. The task is no longer considered from one side. In this the designer functions like the modern architect.

Chapter six traces briefly the centuries old tradition of Realism in scenic design which reasserted itself in the thirties with emphasis for the first time on solid doors, moldings, etc.

The last chapter examines five "painterly" directions of current design which comprise a "New" Romanticism in scenic design. Jointly they have succeeded in diverting stage design from built Realism.

When the design of a play like *Hamlet* can be traced through these major styles, one may conclude that the visual means of design are worked out by the designer as a member of a larger community of artists past and present. Design is not in isolation from other arts.

Microfilm \$2.75; Xerox \$9.70. 211 pages.

#### THE WISCONSIN IDEA IN THE WISCONSIN HIGH SCHOOL FORENSIC ASSOCIATION

(L. C. Card No. Mic 60-4802)

Mary Elizabeth Thompson, Ph.D.  
Northwestern University, 1960

"The borders of the University are the borders of the State." This is the Wisconsin Idea, which has been mentioned by each president from Chancellor Paul Chadbourne--the first President of Wisconsin--to the present. The University believes that it has a duty to educate all the people of the State regardless of race, color, creed, formal education, or age. Chapter One defines the terms to be used in the dissertation, and explains fully the Wisconsin Idea.

In Chapter Two a study of agricultural extension shows that the Wisconsin Idea has provided State-wide education to farmers. But in the school year 1884-1885, prominent farmers threatened to set up a separate agricultural college. The Board of Regents appointed a committee that revised the four-year course, initiated a practical two-year course, and started practical extension courses and agricultural institutes for farmers. The new plan was immediately successful.

Cultural extension, introduced in Wisconsin in 1890, consisted of off-campus lectures by faculty members on subjects of their own choosing. It dwindled in popularity. Chapter Three deals with President Charles Van Hise's decision in 1905 to pattern all extension after agricultural extension. He provided a "separate but equal" faculty exclusively for extension classes. The courses were so

successful that the pleased legislature appropriated larger and larger funds for the University. These expenditures caused the conservatives to conduct an inquiry into University policies. This inquiry, the Allen Survey, grossly misrepresented the University, according to Professor George Mead, of Chicago University, who wrote in *Survey Magazine*, that the professors defended themselves so ably that "no politician has dared to oppose the University since."

Chapter Four describes the establishment of the Wisconsin Lyceum Association, which originated in 1895. By about 1912 declamation, the only contest, was divided into oratory for boys and declamation for girls. In 1916 the new Lyceum President, Mr. William P. Roseman, who was in charge of extension at La Crosse, requested that someone from the Extension Division replace the elected secretary, who had resigned. Miss Almere L. Scott assumed this nonpaying position. With two extension members as officers in the Lyceum Association, the Wisconsin Idea of Extension started influencing high school forensics. By 1922 Miss Scott and the Wisconsin teachers of Speech agreed that the Wisconsin Lyceum Association needed to be modernized. They appointed a committee that worked with Miss Scott for two years. In 1924 Miss Scott tentatively added extemporaneous reading and extemporaneous speaking to oratory and declamation, and sent a report to the Wisconsin Lyceum Association member schools recommending sweeping changes. In 1925 the Wisconsin High School Principals' Association approved her suggestions, made further revisions, renamed the organization the Wisconsin High School Forensic Association, and accepted Miss Scott's invitation to have the Wisconsin Idea of Extension sponsor the revised organization.

The steady, sound growth of the WHSFA since 1925 is related in Chapter Five. High school forensic contests were opened to all high schools, public and private. Mr. Roseman stated that the largest registration of the Wisconsin Lyceum Association was 167 schools. The first year under the Wisconsin Idea the WHSFA had 286 schools. In 1958-1959 the final membership totalled 439.<sup>1</sup>

Chapter Six deals with some of the current problems in the WHSFA, as seen through the eyes of the participating high school coaches, and with steps that might be taken to correct them.

The main conclusion in Chapter Seven is that high school forensics were improved, enriched, and increased through the sponsorship of the Wisconsin Idea of Extension.

1. In 1959-1960 the member schools number 443.

Microfilm \$2.50; Xerox \$7.60. 161 pages.

#### HENRY FIELDING AND THE LONDON STAGE, 1730-1737.

(L. C. Card No. Mic 60-4144)

Kenneth Daulton Wright, Ph.D.  
The Ohio State University, 1960

Henry Fielding, one of England's foremost novelists, had an earlier career of ten years' duration that had nothing to do with the writing of novels. He was one of the leading figures of the London stage from 1728 to 1737, a playwright,



critic, social satirist, theatre manager, and catalyst in the passage of the Licensing Act of 1737 which closed all the theatres except the patent houses. The full story of Fielding's activity in the theatre is a brief but significant chapter in the history of eighteenth-century theatre.

This study is concerned with all aspects of Fielding's life in the theatre during a period when the stage was changing from the sophisticated comedy and pseudo-classicism of the Restoration and early eighteenth century to the comparatively realistic drama of bourgeois sentimentalism, burlesque, and satire. Fielding was a factor in the shaping of this theatre in several important ways.

His ultimate place in the history of the stage cannot be determined by any one or two of the areas discussed in this study. The plays alone would have given him at best a small place in the history of satire and burlesque, although an important one. The story of his theatre innovations and rebellion against conventions would have made him interesting, but hardly important. His brief but vigorous career as a manager would have deserved attention, and his role in the Licensing Act would surely have accorded him some spot in history. Some importance also

must be attached to his comment on the theatre in his plays, novels, and essays. But each of these facets is incomplete as an account of Fielding's work in the theatre.

It is when all of his varied activities are examined together in relation to each other and to the theatre itself that the picture of Henry Fielding as a theatre personality comes into focus. It is only when the parts are assembled into a whole that the final history of Fielding results in a convincing story of a theatre man.

The great novelist of 1742 to 1754 has long overshadowed Fielding the playwright, manager, critic, and theatre figure of 1730 to 1737. But the other lesser-known Fielding is there, giving to the history of the theatre a new kind of satire, a greater form of burlesque, a closer look at accepted conventions, an excellent record of theatre management, and many penetrating comments about the stage. He also was greatly instrumental in causing the theatre to be stifled for over a hundred years by the Licensing Act of 1737. That is the Fielding of this study about a man and his work in the theatre of eighteenth-century London.

Microfilm \$3.25; Xerox \$11.50. 252 pages.

## ZOOLOGY

### DEVELOPMENT OF THE "HATCHING MUSCLE" (MUSCULUS COMPLEXUS) IN UNOPERATED, HYPOPHYSECTOMIZED AND THIOUREA-TREATED CHICK EMBRYOS.

(L. C. Card No. Mic 60-4739)

Wanda Ellen Brandstetter, Ph.D.  
Northwestern University, 1960

An unusual growth pattern has been reported for the "hatching muscle" (*musculus complexus*) by three separate investigators: Keibel, Pohlman, and Fisher. This muscle, which originates on three cervical vertebrae and inserts on the posterior ends of the parietal bones, undergoes rapid hypertrophy prior to hatching and rapid atrophy thereafter. Tissue fluid accumulates rapidly during the period of hypertrophy and disappears quickly thereafter.

The histological changes in this muscle have been carefully examined in unoperated embryos. The possibility that this unusual growth pattern is regulated by endogenous thyroxine or other hormones was investigated by 1) hypophysectomy at 33 hours of incubation by the partial decapitation method of Fugo and 2) injection of thiourea into the yolk sac of 8-day embryos. The effects of hypophysectomy on the histological changes were noted, as well as the effects of both hypophysectomy and thiourea treatment on wet weights, dry weights, relative weights, and water content of the muscle. All embryos examined were incubated 16 to 32 days.

Development of this muscle in unoperated embryos was essentially the same as in other striated muscles until 19 days of incubation; thereafter large numbers of well-developed muscle fibers atrophied and degenerated. By 31 days only a flattened, ribbon-like muscle remained

containing some normal fibers and excessive amounts of connective tissue. Wet weights, dry weights, and relative weights were maximal at 20 to 21 days of incubation. Thereafter they diminished to levels characteristic of 16- to 17½-day control embryos or even lower.

In hypophysectomized embryos growth and differentiation of this muscle were clearly retarded, the retardation becoming progressively greater with increasing age. Degenerative changes were initiated earlier than in control specimens, but did not result in the characteristic reduction in size of the muscle within the period of study. Wet weights, dry weights, and relative weights characteristic of 20- to 21-day controls were not attained by hypophysectomized and thiourea-treated specimens until after 25 or more days of incubation. Accumulation of extracellular gelatinous material, present in large quantities in control embryos at the time of hatching, did not occur in thiourea-treated and hypophysectomized embryos until the 25th and 26th days, respectively. The chemical nature of this substance is not known, but its time of appearance suggests that it may represent breakdown products of muscle degeneration. The water content of this muscle was approximately normal in thiourea-treated embryos; it was considerably greater than normal in hypophysectomized embryos on most days of incubation.

Retarded development of this muscle following interference with thyroxine production suggests that its rate of development is controlled primarily by thyroxine. Since its development was less retarded in thiourea-treated than in hypophysectomized embryos, some other hormone or hormones may be involved in regulating its development. Water content of this muscle seems to be regulated by some hormone other than thyroxine.

The present study does not support the hypothesis of

Pohlman that infiltration of the musculus complexus with excessive amounts of tissue fluid is due to absorption of the yolk sac and cessation of the chorioallantoic circulation. The latter two developmental events do not take place in hypophysectomized and thiourea-treated embryos. Nevertheless, infiltration of the muscle by excessive amounts of tissue fluid does take place in treated and operated embryos.

The present study does not appear to support the hypothesis of Keibel and Fisher that contractions of the musculus complexus provide the power for breaking out of the shell since atrophy and degeneration of muscle fibers are well advanced in this muscle before hatching occurs.

Microfilm \$2.50; Xerox \$6.80. 142 pages.

#### REGIONAL SPECIFICITY OF INHIBITION WITHIN THE CHICK BRAIN

(L. C. Card No. Mic 60-3883)

Maxwell Harold Braverman, Ph.D.  
University of Illinois, 1960

The injection of chick eggs with extracts of adult or embryonic organs as suggested by P. Lenicque, demonstrates the specific inhibitory effect of these extracts on the corresponding embryonic organ system. Tissues are homogenized in Tyrode's or Spratt's normal solutions, centrifuged at 5,000 x g., and one-tenth or two-tenths cm<sup>3</sup> of the supernatant injected into test eggs of twenty-four hours incubation. Neural fractions affect the neural system; mesodermal derivatives their corresponding systems. Eggs receiving injections of the normal saline carrier of the extracts develop an insignificant number of defects.

A pattern of inhibition can be seen if the gross effects of extracts of different parts of the brain are compared. Dorsal cerebral extracts affect only fore-brain formation. Extracts of whole brain inhibit normal formation of the entire brain structure. Spinal cord extracts, in addition to affecting spinal cord, exert an inhibitory influence on the whole brain.

Histological analysis permits a vesicle by vesicle analysis of defective brains. This fine analysis reveals a progressive effect upon posterior brain portions as posterior extracts are considered. The pattern of homologous and anterior inhibition which is seen perhaps is similar to the differentiating mechanism during neural development. A mechanism for carrying out such specific and cumulative inhibition can be constructed if initial differentiations are assumed to consist of a series of reactions, alternative differentiations assumed to be characterized by fewer reactions.

Microfilm \$2.50; Xerox \$3.60. 65 pages.

#### THE RELATION OF ENERGY REQUIREMENTS OF TROPICAL FINCHES TO DISTRIBUTION AND MIGRATION

(L. C. Card No. Mic 60-3896)

George Wyatt Cox, Ph.D.  
University of Illinois, 1960

Measurements of energy requirements for existence were made for four resident tropical finches at 12- and 15-hour photoperiods and temperatures ranging from +4.4°C. to +38.9°C. at Barro Colorado Island, Panama Canal Zone, from February to September, 1959. Species used were the variable seedeater, *Sporophila aurita*, yellow-bellied seedeater, *Sporophila nigricollis*, blue-black grassquit, *Volatinia jacarina*, and the green-backed sparrow, *Arremonops conirostris*.

No significant differences were observed in body weights at the two experimental photoperiods. Weights increased significantly at low temperatures and decreased significantly at high temperatures. Fat free dry weights averaged 2.806 grams for the variable seedeater, 2.660 grams for the blue-black grassquit, 2.380 grams for the yellow-bellied seedeater, and 10.400 grams for the green-backed sparrow. In the variable seedeater, heavier birds tended to metabolize more on a per bird basis but not on a per gram basis.

Gross energy intake increased linearly with decreasing temperature. Intake was greater at the longer photoperiod and showed a greater rate of increase with decrease in temperature.

There was no significant variation in caloric value per gram excrement with temperature or photoperiod. Energy loss in the excrement increased linearly with decreasing temperature. Excretory energy per gram bodyweight was greater at 15 hours and showed a greater rate of increase with decrease in temperature. Excretory energy loss per hour of daylight was lower on the longer photoperiod.

Efficiency of food utilization tended to increase with increasing temperatures. In the variable seedeater, efficiency at 15 hours remained high at lower temperatures than at 12 hours.

Metabolized energy increased linearly with decreasing temperatures. The level was higher and the rate of increase with temperature greater on the 15-hour photoperiod. Per hour of photoperiod, metabolized energy intake was lower on the 15-hour photoperiod.

Low limits of temperature tolerance for the variable seedeater, yellow-bellied seedeater, and blue-black grassquit were 2.8°C. at 12 hours and 0°C. at 15 hours. For the green-backed sparrow, limits were -7.4°C. at both photoperiods. High limits of temperature tolerance at 12 hours were 38.9°C. for the variable seedeater and green-backed sparrow, 40.6°C. for the yellow-bellied seedeater, and 42.2°C. for the blue-black grassquit. At 15 hours, limits were 41.7°C. for the variable seedeater and green-backed sparrow and 43.9°C. for the other two species.

Yearly variation in temperature and photoperiod at Barro Colorado Island is small, but well marked dry and wet seasons occur. Ranges of the species studied extended 20-33 degrees from the equator, where all encounter greater fluctuations of temperature and photoperiod than in the Canal Zone. Breeding seasons and periods of molt occur during time of the year when food is most available and the least amount of energy need be expended in obtaining it.



Productive energy increased linearly with increasing temperature to about 35°C. and at each temperature was greater at the longer photoperiod.

The levels of potential, existence, and productive energy remain nearly constant during the year in the Canal Zone.

In these species, the advantages that would be gained by migration to the latitude of central Illinois for a summer breeding season are small, since the increased level of productive energy obtained is small, is present for only part of the summer, and is at a cost of a considerable increase in energy required for existence.

Limits of distribution as permanent residents may be set at high latitudes by the maximum ability for metabolizing energy on the short photoperiods falling below requirements for existence at the low winter temperatures.

Microfilm \$2.50; Xerox \$3.80. 68 pages.

INHIBITORY CONTROL OF NEURAL  
DIFFERENTIATION IN EXPLANTS OF  
*RANA PIPIENS* GASTRULA ECTODERM

(L. C. Card No. Mic 60-3902)

Norman Arnold Dial, Ph.D.  
University of Illinois, 1960

In recent years evidence has been accumulating in support of the hypothesis of specific inhibition as a mechanism of cellular differentiation. In the present studies, the ectodermal sandwich technique was used in an effort to further test this hypothesis.

Presumptive chorda-mesoderm of early and late gastrula stages of *Rana pipiens* embryos was placed in pieces of presumptive ectoderm of the early gastrula of the same species. These sandwiches were then cultured for three days at 22(+1)°C. in medium containing the supernatant extract of twelve to fifteen homogenized stage 18-23 whole *Rana pipiens* brains. Sandwiches cultured in boiled brain supernatant, ventral ectoderm supernatant, and culture medium only, served as controls.

In another series, presumptive chorda-mesoderm and a piece of stage 21-23 telencephalon were placed alongside each other in ectodermal sandwiches. Controls consisted of sandwiches in which a piece of tail muscle was implanted instead of brain.

Sandwiches treated with supernatant of homogenized brains had fewer forebrains than did the controls. Only 2 of 28 treated explants had forebrains, while 17 of 33 controls had forebrains. Approximately 67% of the treated explants contained hindbrain, while 45% of the controls contained hindbrain. Hindbrains of the treated explants were generally larger than those of controls.

One of the more striking differences between treated and control sandwiches occurred in pigmented cell masses of neural crest derivation. In the treated explants, one often saw large, diffuse masses of this tissue compared to smaller, more compact masses in controls. Also, in several treated explants only spino-caudal type structures were found. It appeared that differentiation had been shifted toward deuterocephalic-neural crest and spino-caudal directions.

In the series in which a piece of brain was implanted

along with chorda-mesoderm, the same general pattern emerged. Three of eighteen treated explants had forebrains, while ten of thirteen muscle implant controls had forebrains, three of which were very large. Again, large masses of diffuse neural crest tissue were found in treated sandwiches, while smaller, more compact masses were found in controls. Also, more eyes were present in the treated sandwiches in this series than in any other series. As in the supernatant-treated series, differentiation seems to have been shifted in directions other than forebrain.

It is concluded that the presence of recently differentiated brain material exerted an inhibitory control over neural differentiation in explants of *Rana pipiens* gastrula ectoderm. Microfilm \$2.50; Xerox \$3.00. 46 pages.

BIOLOGY OF THE MOUNTAIN ASH SAWFLY,  
*PRISTIPHORA GENICULATA* (HTG.).

(L. C. Card No. Mic 60-4082)

Robert Shirley Forbes, Ph.D.  
The Ohio State University, 1960

The mountain ash sawfly, *Pristiphora geniculata* (Hartig), has been known in Europe since 1840 and in North America since 1926, but little has been published about it. Studies were carried out at Fredericton, New Brunswick, from 1950 to 1957 on its hosts, distribution, life history, habits, development, and natural control factors.

Rearing was carried out by standard techniques in a screened outdoor insectary. Cages were used in field studies on oviposition. Radial and shoot growth measurements were taken on the principal host tree, *Sorbus aucuparia* Linnaeus. Larvae were sampled on leaf clusters of *S. aucuparia* trees in the outer and inner crown at different levels, quadrants, and at two periods of larval development. Cocoons were sampled from soil and in earth-filled trays under canopies of trees.

In eastern Canada, *P. geniculata* overwinters as a larva in a cocoon, in litter, or just below the soil surface. Some larvae remain in diapause. Others pupate in the spring, and adults emerge in late June and early July. Oviposition occurs soon after emergence. Eggs are laid around the periphery of the leaflet between the epidermal layers. Larvae feed from two to three weeks, then drop to the ground and spin cocoons. A few individuals produce a second generation in August and September.

All stages are described briefly. Male larvae have four instars, females five. The latter eject about three times as much frass by weight as the former. About 75 per cent of this is ejected in the ultimate instar, indicating that most food is consumed in this stage. Head width analyses of larvae showed five discrete groups. The difference in head widths of male and female larvae in the fourth instar was statistically significant. Comparisons of observed means and those calculated by seven methods indicated that the parabola,  $y = a + bx + cx^2$ , best described the increase in head widths.

A sex ratio of 21 per cent males and 79 per cent females was obtained. Parthenogenesis is facultative or arrhenotokous. Comparison of Canadian adult females with one European specimen showed no important differences in colour or structure.

Since most defoliation occurs late in the season and in the lower crown levels, the trees are not seriously affected. A relationship between degree of defoliation and refoliation was apparent.

Larval numbers differed significantly by crown levels, crown quadrants, and outer and inner crown, whereas flowering did not. Differences in larval density between sampling periods and between the outer and inner crown in different sampling periods were not statistically significant. One sampling is sufficient, but all levels, all quadrants, and the outer and inner crown should be represented. The relationship between the variance and mean of larval numbers was curvilinear, indicating that "over-dispersion" probably occurs.

A relationship was shown between the average amount of June-July rainfall and the severity of sawfly infestations in southern New Brunswick over a 20-year period. High rainfall was usually followed by light infestations the next year. The role of other natural control factors is described. *P. geniculata* lacks adequate density-dependent control factors, and the ultimate limiting factor in the abundance of the sawfly in eastern Canada seems to be its scattered food supply. The introduction of parasites, predators, or disease might be beneficial.

Microfilm \$2.50; Xerox \$8.60. 189 pages.

#### ENDOPARASITISM IN ISOLATED POPULATIONS OF RODENTS OF THE LAKE BONNEVILLE BASIN, UTAH.

(L. C. Card No. Mic 60-3370)

John Christian Frandsen, Ph.D.  
University of Utah, 1960

Chairman: Albert W. Grundmann

A study was conducted to determine the composition of the fauna of haemoprotista and visceral helminths parasitizing members of some of the populations of rodents in the Lake Bonneville Basin of Utah. As a corollary to this phase of the problem, an attempt was made to determine what effects, if any, of the subspeciation of the hosts were reflected in differences in the morphology of the parasites present in hosts belonging to these subspecies. Only rodentine hosts of the parasites were studied. Because of this restriction of the kinds of host sampled, the effects of the subspeciation of the hosts upon their parasites could be studied only with regard to the monoxonous parasites.

Forty-six trapsites were established in and around the Lake Bonneville Basin. Representatives of the following subspecies of rodents were captured at these trapsites: *Eutamias amoenus amoenus*, *E. minimus consobrinus*, *E. minimus pictus*, *E. umbrinus umbrinus*, *Microtus longicaudus latus*, *M. montanus micropus*, *M. montanus nanus*, *Perognathus formosus incolatus*, *P. parvus olivaceus*, *Peromyscus crinitus pirgracilis*, *P. maniculatus rufinus*, *P. maniculatus sonoriensis*, *Reithrodontomys megalotis megalotis*, *Thomomys talpoides gracilis*, *T. talpoides moorei*, *T. talpoides wasatchensis*, *T. umbrinus albicaudatus*, *T. umbrinus aureiventris*, *T. umbrinus bonnevilliei*, *T. umbrinus contralis*, and *T. umbrinus*

*stansburyi*. Specimens of *Neotoma lepida* were examined incidentally for haemoparasitic protista.

Two different kinds of haemoprotistans have been found in addition to one or more different species of trypanosomes belonging to the *Trypanosoma lowisi* group.

Nine species of nematodes have been found in the digestive tracts of these hosts, of which two species, *Ransomus rodentorum* and *Trichuris fossor*, contain monoxonous worms parasitizing rodents belonging to one genus only: *Thomomys*.

Representatives of one species of trematode, *Brachylaime microti*, have been found. These flukes were found only in mice of the subspecies *Peromyscus maniculatus sonoriensis*.

Only one species of acanthocephalan, *Moniliformis clarki*, was found represented in these rodents. These worms were found in representatives of *Peromyscus maniculatus* and *Thomomys umbrinus*.

Adult representatives of 3 species of cestodes, *Catenaenia linsdalei*, *Hymenolepis citelli*, and *H. horrida*, were found. Adult cestodes belonging to 3 species of the Anoplocephalidae were also found, but identification of these latter worms has not yet been completed. Larval representatives of *Cladotaenia corci*, *Parutorina candelabraria*, and *Mesocostoides carnivoricolis* were recovered.

No morphological differences were noted between members of the same kind of monoxonous parasite found in different kinds of hosts.

Representatives of two species of monoxonous parasitic nematodes have been found in pocket gophers. These species are *Ransomus rodentorum* and *Trichuris fossor*. Members of the species *Ransomus rodentorum* have been found only in representatives of *Thomomys talpoides gracilis*, *T. t. wasatchensis*, *T. umbrinus albicaudatus*, and *T. u. stansburyi*. Utilizing the results of studies conducted on the ecology of pocket gophers, the distribution of *Ransomus rodentorum* in these hosts appears to lend support to the theory that when the western slopes of the Wasatch Mountains became habitable after the decline of Lake Bonneville, northern and southern pocket gophers competed for habitat sites in the region where the distributional ranges of *Thomomys talpoides wasatchensis* and *T. umbrinus albicaudatus* now meet.

Microfilm \$2.50; Xerox \$8.00. 175 pages.

#### AN ELECTROPHYSIOLOGICAL APPROACH TO THE STUDY OF REPELLENCY IN *PHORMIA REGINA* (MEIGEN)

(L. C. Card No. Mic 60-4235)

Richard Thornton Guest, Ph.D.  
Rutgers University, 1960

Major Professor: Andrew J. Forgash

Recent investigations have indicated that it is possible to recover afferent nerve impulses, by electrophysiological techniques, from the contact chemoreceptors (sensilla trichodea) on the labellum of the blowfly, *Phormia regina* (Meigen).

In the present research, electrophysiological techniques have been employed in an effort to ascertain the



ability of several proprietary organic chemical fly repellents to induce nerve impulses in the tarsal contact chemoreceptors of *Phormia regina* (Meigen), and to seek a possible "common denominator," exhibited in the form of characteristic impulse spikes or trains, which may be used to determine experimentally the effectiveness of candidate repellent compounds.

Four fly repellents--di-n-butyl succinate, Crag Fly Repellent, Indalone, and 5770 (an experimental compound)--were tested initially at concentrations of 0.1%, 0.2%, 0.4%, 0.8%, and 1.6%. Stimulation consisted of lowering a small glass micropipette over a sensillum on an excised prothoracic leg of a female *Phormia*. The electrical impulses, recovered from the tip of the sensillum, were conducted to a high impedance probe by means of a silver chloride electrode and subsequently to an A.C. preamplifier and cathode-ray oscillograph. Signals previously filtered to pass between 600 and 1000 c.p.s., were monitored through a loudspeaker and simultaneously tape recorded. Individual tests were conducted for 0.5 minute.

Because of the similarity between the impulse trains obtained by stimulation with Indalone and those reported from stimulation of a sensillum by DDT, further investigations were conducted on continued stimulation of individual sensilla at lower concentrations of the repellents and DDT.

Behavioral tests were carried on in conjunction with the electrophysiological investigations on normal *Phormia regina* (Meigen). These tests consisted of two J-tube potometers placed in a one-quart Mason jar containing twenty flies. One of each pair of J-tubes contained glass-redistilled water while the other contained the desired concentration of the repellent in the control solution. The number of milliliters required to return the level of the solution to an original mark was taken as an indication of feeding. Similar tests were conducted on antennectomized-palpectomized *Phormia* at concentrations which exhibited a high level of repellency to the normal flies.

The electrophysiological investigations indicated a general increase in excitability of the sensilla when stimulated by the repellent compounds, which correlated with the t-values calculated from the feeding responses of normal flies. This may be due to a general toxication of the nervous tissue, since the activity was similar to that observed during stimulation by DDT. Or, it may be true that the materials were causing an irritability of the sensilla which, if transmitted to the central nervous system of the insect, would be manifested as a general avoidance response.

It may be concluded, from normal and antennectomized-palpectomized *Phormia* subjected to the behavioral test, that avoidance of the test materials probably was due primarily to an olfactory stimulation caused by these materials. This was shown by the fact that removal of the olfactory receptors apparently increased the acuity of the common chemical sense which caused these flies to exhibit a general and rather uniform avoidance of the unfavorable stimuli, regardless of concentration.

In the present research it was impossible to distinguish any characteristic response of the sensilla, by the electrophysiological techniques employed, which could be used to determine experimentally the effectiveness of candidate repellent compounds.

Microfilm \$2.50; Xerox \$5.00. 98 pages.

MORTALITY OF TWO BEETLES,  
*ARAECERUS LEVIPENNIS* JORDAN AND  
*MIMOSESTES SALLAEI* (SHARP), IN  
FIELD POPULATIONS.

(L. C. Card No. Mic 60-4659)

Alden Dexter Hinckley, Ph.D.  
University of Hawaii, 1960

Current theories of mortality in natural populations are reviewed, with emphasis on their differing empirical implications. The physical conditions and dominant plants of ten research areas on south-east Oahu, leeward of the Koolau Range, are described. Notes are given on the nomenclature, bionomics, and competitors of the anthribid, *Araecerus levipennis* Jordan, and the bruchid, *Mimosestes sallaei* (Sharp). Furthermore, the techniques and results of collections and experiments are presented.

Weekly collections of maturing pods of koa haole, *Leucaena glauca* (L.) Benth., produced evidence that pods were susceptible to attack by *A. levipennis* from the time at which seeds started to swell until the time the pods turned brown, a period lasting from 1 to 3 weeks. The shorter periods were more common in xeric environments (during the summer and in the Diamond Head area); the longer, in moist environments (during the winter and in the Waahila Hill area). Survival of eggs was high in newly susceptible koa haole pods but low in pods of koa haole which had already been heavily attacked and in the fleshy pods of klu, *Acacia farnesiana* (L.) Willd. Larval starvation was frequent on hard seeds under dry conditions and on moldy seeds in wet situations. Experimental reduction of infestation density increased survival of *A. levipennis*. This was attributable to diminished exudation and moldiness rather than lower parasitization or less intense intra-specific competition.

*M. sallaei* could oviposit on any klu pods more than 6 weeks old. Many eggs were removed by predators and some were parasitized by the trichogrammatid wasp, *Uscana semifumipennis* Girault. Most important, however, was mortality from factors associated with exposure, possibly heat and desiccation. Some larvae of *M. sallaei* starved on klu seeds destroyed by competitors such as the fungus, *Aspergillus* sp., and the olethreutid moth, *Cryptophlebia illepidia* (Butler). Counts of emergence holes in 3066 seeds infested by *M. sallaei*, collected on leeward Oahu during 1958-1960, indicated that parasitization by the braconids, *Urosigalphus bruchi* Crawford and *Glyptocolastes bruchivorus* Crawford, was 31 per cent, while that by two smaller wasps, the eulophid, *Horismenus* sp., and the pteromalid, *Lariophagus texanus* Crawford, was 17 per cent. Data from collections and experiments suggested that the larval parasites were neither hampered by the sparsity nor aided by the crowding of their hosts.

The inability of *A. levipennis* to attack brown koa haole pods prevents it from maintaining populations on isolated bushes. Environmental conditions favoring moldiness or hardness of koa haole seeds are detrimental to the survival of *A. levipennis* larvae, but the grubs of *M. sallaei* can develop in hard klu seeds. Physical barriers appear to limit the effectiveness of parasites, especially those attacking larvae of *M. sallaei*. The final conclusion is that theories and investigations of mortality in natural populations should include balanced consideration of direct and

indirect effects of weather, availability and condition of food, frequency of inter-specific and intra-specific competition, as well as physical and behavioral limitations of the animals and their enemies.

Microfilm \$2.50; Xerox \$6.00. 125 pages.

THE NERVOUS SYSTEM OF CERTAIN ABDOMINAL SEGMENTS AND THE INNERVATION OF THE REPRODUCTIVE SYSTEM AND GENITALIA OF THE MALE CECROPIA MOTH *HYALOPHORA CECROPIA* LINN. (LEPIDOPTERA: SATURNIIDAE).

(L. C. Card No. Mic 60-4241)

John Lester Libby, Ph.D.  
Rutgers University, 1960

Major Professor: John B. Schmitt

The musculature and its innervations in the fourth pre-genital abdominal segment of the *Hyalophora cecropia* Linn, male moth are described. Dorsal, ventral, and transverse pairs of nerve roots arising from the pregenital abdominal segmental ganglion seem to be homologous with those described for the pregenital abdominal segments of certain Orthoptera (Schmitt, 1954), in the neuropteran, *Chauliodes formosanus* (Maki, 1936), and in the cecropia larva (Libby, 1959). In the Lepidoptera, as exemplified by *Hyalophora*, as in these other orders, the dorsal nerve fuses with the transverse nerve of the preceding ganglion and the spiracular muscles are innervated from the fused branches of the dorsal and transverse nerves. The ventral nerve fuses with the transverse nerve of its own segmental ganglion in *Hyalophora cecropia* and some Orthoptera. These homologies in such widely separated orders as Neuroptera, Orthoptera, and Lepidoptera support the concept of a basic segmental nerve pattern within the Hexapoda.

The terminal abdominal ganglion of the male cecropia moth is located in the sixth abdominal segment and gives rise to the lateral nerves of the sixth, seventh, and eighth abdominal segments, as well as the nerve trunk which gives rise to the nerve branches innervating the reproductive system and genital musculature. The vasa deferentia of the male moth of *Hyalophora cecropia* loop beneath the lateral nerves innervating the rectum, the anal tube, and the body wall in the anal area. If these relationships are homologous with the position of the lateral nerves of the eleventh abdominal segment in Orthoptera, as shown by Snodgrass (1936), it follows that the nerves passing above the vasa deferentia are the lateral nerves of the eleventh abdominal segment, which is no longer recognizable as a segment in *Hyalophora*.

Microfilm \$2.50; Xerox \$3.80. 67 pages.

THE SEASONAL AND RELATIVE ABUNDANCE OF THE MAJOR INSECTS OF THE PASTURE AND MEADOW HABITAT OF CENTRAL ILLINOIS

(L. C. Card No. Mic 60-3949)

John Arthur Lowe, Ph.D.  
University of Illinois, 1960

The main phytophagous insects inhabiting pasture and meadow areas of central Illinois have been collected and evaluated for five years. A list of these forms with relative abundance and seasonal distribution is presented. The population found was noted as being composed of several major insect species which were found commonly throughout the study. It is pointed out that the insects inhabiting grass areas are present in fairly constant numbers each year, and their times of appearance are quite consistent during each season.

A portion of the paper presents information concerning the effectiveness of collecting methods used. The sweep net is considered a good method of collecting insects, but a number of factors influence the number of insects taken in this way. Wind velocity is shown to affect the number of insects collected with a sweep net, and the velocities are shown to be proportional to the number collected. It is proposed that the sweep net can be correlated with these velocities in a manner which will allow this method to be used as an accurate means of determining numbers of insects per area.

A vacuum sampler which sucks up all insects from a measured area was constructed for this study in an effort to ascertain accurately the true populations found in the pastures. The device was very effective if large enough areas were included in a single sample. Sampling data indicated that the insects inhabiting pastures are not distributed evenly over the field. For this reason, samples must include sufficient surface area to provide data that does not show great variability.

Microfilm \$2.50; Xerox \$4.20. 80 pages.

A POPULATION SURVEY OF THE RING-NECKED PHEASANT IN MICHIGAN

(L. C. Card No. Mic 60-3418)

Ralph Austin MacMullan, Ph.D.  
Michigan State University, 1960

Major Professor: George J. Wallace

This study of Michigan's pheasants from the standpoint of population dynamics had three objectives--(1) to reconstruct a history of past populations, (2) to acquire information on current population levels, and (3) to devise better sampling methods for obtaining that information. The study was made chiefly during the years 1947-1950, but data were collected each year thereafter through 1956. The work was sponsored by Federal Aid in Wildlife Restoration Project, Michigan 38-R.

Although a number of private releases were made beginning in 1895, pheasants were not established until after 1918 when the State began a release program. Pheasants were well established by the early 1920's and the first



pheasant open season for hunting was held in 1925. Reports from hunters were the best source of information prior to this study. The State's computed kill based on compulsory hunter reports was determined to be a good index to fall populations.

Pheasant distribution is outlined, and a correlation with land and soil formations described. Five study areas were selected. Each had a distinctive pheasant population and land formation, and in total comprised about three-quarters of the primary pheasant range.

Data were collected from extensive surveys made by sportsmen, farmers, biologists, rural mail carriers, and conservation officers. Roadside surveys by the mail carriers and conservation officers were most useful, and complemented each other. The approximately 500 carriers who regularly cooperated provided good volume of data, but could be asked only infrequently to make surveys. The officers (about 55 in pheasant range) did not provide as large a volume of data, but could be asked to record observations over long periods to determine the effect of phenology on surveys.

Surveys were made during the four seasons. Data were recorded by county units, and examined by tabulations for study areas.

Spring--Crowing-cock counts, self-adjusting for phenology, were considered the most reliable for spring cock population estimates. Carriers' spring surveys of both pheasant density and sex ratio were sensitive to phenological differences. As the days progressed in mid-April, observed density increased. The carriers' counts were correlated to crowing-cock counts, suggesting a method for adjusting counts for phenology. Sex ratios obtained from observations of harems may be more nearly true than those obtained from all observations.

Summer--Brood density indices increased as the summer progressed from early June to mid-August, at a predictable rate, permitting adjustment for timing of brood counts. Summer brood counts by carriers showed an excellent correlation with fall kill. From the former, kill could have been predicted with an average error of 4 per cent (greatest error 15 per cent) in an 11-year period. Brood sizes reported by carriers did not change significantly from year to year.

Fall--September extensive roadside surveys during mid-day were valueless. Because of differential vulnerability of adults and young cocks to hunting, I was unable to determine true cock age ratios. Sex ratios reported by hunters were not valid. Hunter success data, discreetly used may yield valid indices to fall populations, but computed kill remains the best index.

Winter--Roadside observations of pheasants was correlated with snow depth. Regressions of cocks, hens, total birds and sex ratio noted by officers each day on daily average snow depths were plotted for two entire winters. The regression was apparently not linear; in addition the regression differed for cocks and hens, and hence sex ratios changed as snow depth increased. In no regressions did the Y-intercepts and the slopes show the same relationship. Interpretation of the data was hampered by a lack of a knowledge of the true population dealt with.

Populations trends by study area from 1937 to 1956 were reconstructed and discussed. Areas of lake-bed soil origin showed similar patterns, although widely separated geographically.

Microfilm \$2.50; Xerox \$8.60. 186 pages.

#### THE AMINO ACID COMPOSITION OF TRICHOMONAD PROTOZOA

(L. C. Card No. Mic 60-3958)

Krishna Nandan Mehra, Ph.D.  
University of Illinois, 1960

Paper electrophoretic studies of the hydrolysates of *Tritrichomonas foetus*, *Tritrichomonas suis*, *Trichomonas gallinarum*, *Trichomonas gallinae*, *Trichomonas hominis* and *Paratrichomonas* sp. from pig rectum revealed the presence in all species of aspartic acid, glutamic acid, arginine and/or lysine. One band which migrated relatively little might have contained several amino acids. An unidentified band which migrated beyond the fastest basic amino acid was also present. In an unhydrolyzed *T. foetus* extract, glutamic acid and arginine and/or lysine, two bands similar to those in the hydrolysate, were identified. Unidimensional paper electrophoresis was not found to be a satisfactory method for the separation of amino acids. The electrophoretic patterns of the 6 species studied looked the same and it was not possible to distinguish one species from another.

Aspartic acid, threonine, serine, glutamic acid, glycine, alanine, valine, isoleucine, leucine, tyrosine, phenylalanine, histidine, lysine and arginine were found and their amounts determined by column chromatography in the hydrolysates of *T. foetus*, *T. suis*, *T. gallinarum*, *T. gallinae* and *Paratrichomonas* sp. Aspartic and glutamic acids were highest in amount in all species. The lowest in all species was histidine. Proline was present in all species but in an amount too small to be studied quantitatively. An unidentified compound which emerged from the column later than arginine was found in all species. In addition to the above amino acids, cystine, cysteine and methionine may have also been present in amounts too small to be detected. There were some differences in the quantities of different amino acids in the various species, and it is possible that trichomonad species may be identified on the basis of the amounts of amino acids which they contain.

Microfilm \$2.50; Xerox \$4.00. 73 pages.

#### MICROSPECTROPHOTOMETRIC MEASUREMENTS OF DEOXYRIBONUCLEIC ACID IN FEULGEN-STAINED NUCLEI OF THE ANTERIOR PITUITARY CELLS OF THE WHITE RAT

(L. C. Card No. Mic 60-3960)

Edward William Millhouse, Jr., Ph.D.  
University of Illinois, 1960

In the past ten years the development of the microspectrophotometric instrument and the technique for its use has made this instrument a valuable tool in the investigation of cellular components in tissue sections. The Feulgen reaction has previously been investigated thoroughly and gives an accurate indication of the amount of nuclear DNA present in cells. The cytological and histochemical studies of the anterior pituitary have produced many significant findings concerning the actions of the three different types of pituitary cells. Interest in the technique, the equipment, and the pituitary gland prompted the author to

investigate microspectrophotometrically the amount of nuclear DNA in Feulgen stained anterior pituitary cells. This study investigated the possible degree of ploidy and the stability or instability of the nuclear DNA content.

Sprague-Dawley albino rats ranging in weight from 106 grams to 525 grams were used in this study. The techniques employed for removing the pituitary glands, for fixation and embedding, and for the mounting of sections are discussed in detail. Three fixatives were used: 20% Neutral Formalin, Carnoy's fluid, and Carnoy's with chloroform. Pieces of liver were removed at the same time and were used as control tissues for which the ploidy of the nuclear DNA is known. The microphotometric instrument and the technique involving photometric measurements of the Feulgen dye-DNA complex is discussed, and the method for the calculations of the DNA arbitrary units is presented.

In all of the liver sections in which measurements were made using the three different fixatives, a majority of the nuclei were grouped about a 4N DNA complement. There were some intermediate values between the 2N and 4N nuclei, but this situation may be due to a building up of DNA prior to chromosome replication. The results represent 450 DNA measurements of Feulgen stained liver nuclei with 150 for each of the three fixatives used and 50 within each group. In contrast to the constancy exhibited by the liver measurements the anterior pituitary Feulgen stained nuclei demonstrated a somewhat wider variation. One thousand eight hundred nuclei were measured with 600 for each of the three fixatives used and 200 within each age group. There are a few nuclei represented in the histograms of the three differently fixed anterior pituitary sections that may be polyploid.

The data for the Feulgen stained liver nuclei presented in the dissertation reconfirm the polyploidy of liver tissue described in earlier studies of other workers. The results of the anterior pituitary measurements demonstrate wider variations in nuclear DNA than the liver measurements show and do not reveal the over-all polyploidy of the liver. The main central group of DNA values fall within a range giving 25 - 30% over-all variation. The wider variation in nuclear DNA content may be explained in one or more of the following ways: (1) it may be due to certain technical inconstancies of the one wavelength method used for measuring the Feulgen stained nuclei; (2) this may be a case of aneuploidy, in which the chromosome number is not a true multiple of the basic number of the chromosomes involved; however, in the absence of actual chromosome counts, the presence of aneuploid nuclei can not be established at this time; (3) the variations may present an indication of some degree of fluctuation in the DNA content of the different pituitary cell nuclei. Each of these suggestions is discussed. Though the data presented are probably best interpreted as supporting the constancy hypothesis, the possibility of varying DNA content for the nuclei of the different functional classes of the pituitary cells should not be ignored. Microfilm \$2.50; Xerox \$3.00. 49 pages.

THE DEVELOPMENT OF THE CLOVER MITE  
(*BRYOBIA PRAETIOSA*, KOCH, TETRANYCHIDAE)  
IN RELATION TO THE NITROGEN, PHOSPHORUS,  
AND POTASSIUM NUTRITION OF ITS HOST.

(L. C. Card No. Mic 60-4246)

Oswald Nathaniel Morris, Ph.D.  
Rutgers University, 1960

Major Professor: John B. Schmitt

Three experiments were carried out under greenhouse conditions between November 2, 1958 and March 12, 1959, and a fourth experiment between November 2 and December 12, 1959, to determine the effect of nitrogen, phosphorus, and potassium nutrition of bush lima bean plants on the duration of oviposition, longevity, embryonic development, duration of the adult stage, number of eggs laid, percentage hatch, duration of postembryonic development, total life cycle, and number of second-generation adults of the clover mite (*Bryobia praetiosa*).

The mites were isolated on leaves of bush lima bean plants supplied with low, medium, and high concentrations of nitrogen, low, medium, and high concentrations of phosphorus, and low, medium, and high concentrations of potassium in nutrient solutions otherwise complete for the growth of plants. Mites were also isolated on leaves of plants supplied with three concentrations of the macronutrients of a complete nutrient solution. The low nutrient level contained 0.1 the concentrations of the macronutrients of the complete nutrient solution; the medium nutrient level contained full concentrations of the macronutrients of the complete solution, and the high level contained three times the concentrations of the macronutrients of the complete solution. Low phosphorus and low potassium levels were run concurrently with the three nitrogen levels.

Chemical analyses showed that the nitrogen, phosphorus, and potassium concentrations of the foliage increased with increased supply of these three nutrient elements.

The greenhouse temperature varied mostly between 50° and 70°F and the relative humidity mostly between 40% and 70% during the period of the entire study. Although the humidity in the greenhouse varied between 30% and 95%, the construction of the mite cages was such that the relative humidity within the cages, in all experiments, was presumably consistently high. Over the same period, radiant sunlight energy outside the greenhouse varied mostly between 170 and 390 gram calories per sq. cm. per day, of which about 60% entered the greenhouse.

In *Bryobia praetiosa*, duration of oviposition, longevity of first-generation mites, number of eggs laid, total number of second-generation adults per mite, and the duration of the adult stage increased directly with an increase in the nitrate-free nitrogen content of the foliage (from 1.87 per cent to 5.51 per cent dry weight) on which the mites fed. Duration of embryonic development and percentage hatch showed no correlation with nitrogen content of the foliage. Duration of postembryonic development and length of total life cycle decreased when nitrogen concentration of the foliage increased, duration of postembryonic development decreasing only slightly. About six times as many mites developed on medium-nitrogen plants and eleven times as many developed on the high-nitrogen plants as did on low-nitrogen plants.

Duration of postembryonic development was shortest



and the total number of second-generation adults per mite was largest when clover mites were fed on leaves of plants supplied with a 5 ppm concentration of phosphorus, compared with the duration of postembryonic development and the number of second-generation mites developing on plants supplied with 1 ppm and 30 ppm phosphorus. The differences in the duration of postembryonic development at the three phosphorus levels were only slight.

The number of second-generation adults per mite was largest on plants supplied with a concentration of 40 ppm potassium, compared with the number developing on plants supplied with 10 ppm and 160 ppm potassium. The differences in the numbers developing at the three potassium levels were only slight.

Duration of oviposition, longevity of first-generation mites, total number of second-generation adults, duration of the adult stage, and probably the number of eggs laid and hatched, increased when the macronutrients of a complete nutrient solution for the growth of plants were increased from 0.1 to 3.0 times the concentrations of the macronutrients.

The life history of the clover mite, based on a study of 585 individuals under greenhouse conditions, is given.

Microfilm \$2.50; Xerox \$5.20. 102 pages.

A STUDY OF THE CHRONIC EFFECTS OF ENDRIN, AN INSECTICIDE, ON THE BLUNTNOSSE MINNOW, *PIMEPHALES NOTATUS* (RAFINESQUE), AND ON THE GUPPY, *LEBISTES RETICULATUS* (PETERS).

(L. C. Card No. Mic 60-4117)

Donald Irvin Mount, Ph.D.  
The Ohio State University, 1960

An investigation of the chronic toxicity of endrin to guppies and bluntnose minnows was conducted for a period of 291 days. The fishes were maintained in continuously renewed solutions of endrin.

Neither species could withstand concentrations greater than .5 parts per billion of endrin in water for more than a few days. Less than 50 per cent of the test animals could live in .5 ppb. for more than thirty days. Approximately 65 per cent of them could live in .4 ppb. for periods exceeding thirty days, while no mortality due to endrin occurred in .25 and .1 ppb. endrin in water.

Fish suffering from endrin poisoning exhibited symptoms (e.g., increased ventilation rate, convulsions, and loss of equilibrium) indicating that the central nervous system was affected. Sub-lethal concentrations caused increased activity and hypersensitivity to stimuli. No cell damage was found in the fish that were able to survive in endrin concentrations, and essentially no physical effects other than increased activity were noted. Adult female guppies ceased to have young when placed in endrin concentrations, but the gonads of the bluntnose minnows were approaching sexual maturity when the test was terminated.

In continuous-flow acute toxicity tests, it was found that the 96 hour  $TL_{50}$  values ranged from .27 ppb., for fish 30 mm. standard length, to .47 ppb., for fish 56 mm. standard length.

Endrin had no effect on oxygen consumption in the seven bluntnose minnows tested. Neither did acute ex-

posure to endrin significantly affect the ability of the fish to swim against a current of water.

In carp exposed to concentrations of 2.5 to 10 ppb. endrin during periods varying from 2.5 to 28 days, the digestive tract, liver, heart-spleen-blood and kidney contained the highest accumulations of endrin. The maximum concentrations of endrin found in the tissues were approximately 160 times as great as those in the water in which the fish were living.

The concentration of endrin in the heart-spleen of a carp exposed twenty-eight days to 2.5 ppb. was found to be 400 ppb. Muscle tissue was consistently low in endrin content. The gills were always low or negative in endrin content, whereas the digestive tract was consistently high, indicating that endrin probably enters the body through the intestine.

Endrin does not appear to be cumulative in its effects on guppies and on bluntnose minnows. Little or no tissue damage was found in those fish which could live in water containing endrin, and fish seemed to recover completely from one exposure to endrin. The increased activity caused by very low concentrations of endrin could be very damaging to fishes in natural waters, disrupting spawning and subjecting the fish to predation and other decimating factors.

Microfilm \$2.50; Xerox \$6.20. 128 pages.

PHYSICO-CHEMICAL STUDIES OF THE MALARIAL PARASITE, *Plasmodium lophurae*, AND ITS HOST, THE CHICKEN.

(L. C. Card No. Mic 60-4794)

Irwin William Sherman, Ph.D.  
Northwestern University, 1960

Adviser: Robert W. Hull

The studies described in this thesis involve alterations in an avian host, the chicken, produced by the obligate, intracellular parasite, *Plasmodium lophurae*, as well as studies on the malaria parasite itself. The scope of the induced pathology and characteristics of the parasite have been limited to investigations of the host's blood proteins and the pigment and protein composition of the parasite. The analytical tools for this work were paper electrophoresis, spectrophotometry, and ultracentrifugation.

Serial studies of the serum proteins of the immature chick infected with *P. lophurae* as investigated by means of paper electrophoresis reveal a qualitative change in the gamma-globulin; a significant crisis period depression of albumin; no alteration of the alpha-globulin and alpha-lipoprotein; a significant crisis period rise in the beta- and gamma-globulins with the former persisting in higher amounts well into the latent period. The immunological and pathological significance of such alterations is discussed.

Attempts to correlate chemical fractionation with electrophoretic entities revealed that ammonium sulfate fractionation is an inefficient technique for the characterization of the serum components of the chicken. Analysis by paper electrophoresis revealed that the alpha- and beta-globulins have a broad precipitation range and remain in solution even at 50% saturation. The euglobulin

precipitated by water dialysis and the precipitate formed at 33.3% saturation of serum with ammonium sulfate includes both gamma- and beta-globulins.

Electrophoresis of the chicken hemoglobins during the course of the malarial infection showed no significant qualitative changes.

Since critical physico-chemical determinations on the parasites *per se* require preparations of considerable purity, techniques involving saponin hemolysis, buffer washes and desoxyribonuclease were developed to produce erythrocyte-free suspensions of plasmodia showing minimal contamination. Spectrophotometric and electrophoretic analyses of the hemozoin (malarial pigment) from such purified preparations indicate the pigment to be an iron-containing porphyrin-protein complex which differs from the hemozoin of other malarias, and is distinct from hematin. The soluble parasite proteins when studied by paper electrophoresis and ultracentrifugation demonstrate homogeneity and to some degree resemble the hemoglobin of the chicken erythrocyte.

Microfilm \$2.50; Xerox \$4.80. 95 pages.

#### AN ECOLOGICAL STUDY OF AN ACID POND IN THE NEW JERSEY COASTAL PLAIN

(L. C. Card No. Mic 60-4262)

Roland Fred Smith, Ph.D.  
Rutgers University, 1960

Major Professor: Dr. Harold H. Haskin

Turkey Lake is a shallow, unstratified seepage lake (0.45 hectares) on the western edge of the outer Coastal Plain in Burlington County. It differs from most south Jersey "cedar waters" in its extremely clear color, which is attributed to the low dissolved organic and suspended matter.

The hydrogen-ion concentration remains quite consistent throughout the year (pH 4.1-4.5) with only slight diurnal fluctuations. The bottom water is usually slightly less acid, probably due to ferric carbonates. The acidity is attributed to sulfuric acid, which may be produced in several ways.

The water level in Turkey Lake, like other impoundments along the outer coastal plain, tends to maintain a constant level because of the sandy soil. Oxygen values usually remain below saturation level throughout most of the year in this type of water, probably due to the high chemical and biological demand and the low primary production.

Turkey Lake water ranks among the softest of surface waters; its salinity is 15.8 mg/liter, alkalinity ranges between 1.5 and 7.5 mg/liter. Nitrates and phosphorus are extremely low. A "complete" analysis of the dissolved minerals is presented. The data suggest that the chemical conditions in this lake remain quite uniform throughout the year.

Iron assumes an important role in the trophic dynamics of this lake; it forms organic complexes ("floc") on the macrophytes and along the open bottom area and contributes to most of the seston. This floc appears to offer a favorable habitat for micro-organisms; bacteria are abundant.

The floc and its associated biota are an important source of food for most of the invertebrate forms.

Monthly plankton, oxygen, temperature and pH data collected over an eighteen-month period are included, also weekly data from May through mid-September during the summers of 1955 and 1956. The detailed sampling of the macrophytes and floc communities was undertaken during August 10-16, 1956. Data on fish and some macro-invertebrates were secured by draining the lake in mid-October, 1956. These standing crop data were projected to estimates of the annual net and gross production. Plankton primary production studies, based on measurements of oxygen or carbon dioxide evolved, were in good agreement with the estimate of seston production. Light-dark bottle studies conducted in 1958 helped to validate the 1956 estimates of production in the macrophyte and bottom floc communities.

The microfauna and flora present in this lake are typical of those found in soft-water lakes throughout the world. The limited fish fauna is generally typical of other highly acid New Jersey waters.

The primary production of the pelagic area appears to be lower than any water mass reported on in the literature. The production of the floc communities raises the total primary production of the lake to a level of moderately high oligotrophy.

The trophic structure suggests a system surprisingly high in primary producers and consumers but disproportionately low at the secondary and tertiary levels. Such a trophic organization should lead to a high turnover of essential nutrients which would account for the relatively high production at the lower trophic levels.

The absence of organisms throughout the trophic structure common to small ponds suggests the presence of limiting factors in the environment. These appear to be of a chemical nature; they may be directly toxic at a given stage in an organism's life cycle or may be limiting in a nutritional sense. The low calcium content is probably insufficient to counteract toxic effects of heavy metals, such as copper.

Microfilm \$2.60; Xerox \$9.00. 197 pages.

#### BEHAVIORAL AND MORPHOLOGICAL VARIATION IN CLOVER MITES FROM DIFFERENT HOST PLANTS

(L. C. Card No. Mic 60-3998)

Robert John Snetsinger, Ph.D.  
University of Illinois, 1960

The clover mite, *Bryobia praetiosa* Koch, is a serious pest on fruit trees and a nuisance problem in dwellings in temperate regions of the world. At the present time, this species of mite has been reported from 186 species of plants. On different hosts, the clover mite shows variation in behavior and morphology. This variation has been interpreted in several ways. Some workers have considered all variation to be of specific importance. There are about 70 scientific names associated with the clover mite. Over one-half of these have come into use since 1956. Other workers, however, continue to treat the clover mite as one species.

The author investigated the behavioral and morphological



characteristics of clover mites from different host plants in order to establish what kind of variation is environmentally induced and what traits are of taxonomic value. A considerable amount of effort is devoted to study of clover mites from apple trees and from lawns near dwellings and tree trunks, because these two strains appear to represent the extremes in variation.

Clover mites on apple trees are active from mid-April until the end of summer. During this time they have three complete generations in most years and in some years a partial fourth generation. Clover mites in lawns near dwellings and trees are active from March until late May, remain as dormant eggs during the summer months, and become active again in early fall. Feeding may occur even in mid-winter on bright, sunny days. In this habitat there are three spring and three fall generations. In habitats other than these two types, clover mites have seasonal histories closely related to one of the two or intermediate between them. The time of day at which feeding occurs in all clover mite habitats is greatly affected by temperature. Most of the feeding occurs when the habitat temperatures are in the vicinity of 50°F. to 70°F.

The egg stage of the clover mite shows a marked adaptation to temperature and humidity. In different habitats the time required to hatch and the per cent of the eggs hatching change greatly with the season. Eggs from females collected from apple trees and from females collected from the basal bark of elm trees when laid and incubated at 60°F. to 65°F. in the laboratory hatch in about 10-15 days. However, field-collected eggs from these two habitats required longer and shorter periods of time to complete incubation than the eggs laid and incubated in the laboratory. High temperatures and low humidities tend to reduce the per cent of the eggs hatching. It is apparent that seasonal effects induce clover mite to go into a dormant or diapause condition. Further development of the eggs only occurs following conditioning periods of cool or cold weather. The duration of the dormant periods varies with the habitat.

Experiments indicate that while it is possible successfully to establish colonies of clover mites transferred from the basal bark of elm trees and other similar habitats to apple and other species of fruit, it is not possible to reverse this procedure. Also after several generations on the apple host, the former basal elm bark strain of the clover mite takes on behavioral and morphological characteristics normally characteristic of clover mites found on apple trees in nature. There appears to be good reason to be skeptical of the classifications of the clover mite that describe species endemic to host plants.

Microfilm \$2.50; Xerox \$8.00. 172 pages.

#### INTRACELLULAR pH AND THE ELECTRIC CHARGE ON THE COLLOIDS IN LIVING INTACT CELLS

(L. C. Card No. Mic 60-3699)

Karumuri Satyalinga Swami, Ph.D.  
University of Pennsylvania, 1960

Supervisor: Dr. R. E. Davies

The investigations on isolated cell components must be conducted in an environment which closely approximates

the conditions found in living intact cells. Especially, it is very important that the concentration of hydrogen ions employed in these investigations should be the same as that of the concentration of hydrogen ions inside living intact cells, as cell components contain large amounts of proteins.

The methods that have been used in attempts to estimate directly the intracellular concentration or activity of hydrogen ions in intact living cells are subject to many kinds of errors and the results are doubtful. Hence, this problem of the determination of intracellular pH was approached indirectly in the present investigations.

*Paramecium multimicronucleatum*, and eggs of *Hydroides*, *Spisula*, and *Echinarachnius* were exposed to an electric field and the net charge on the cell components and cell surface was studied both *in vivo* and *in vitro*.

In intact living cells, the cell components showed a net positive sign of charge on them. *In vitro* experiments on isolated cell components of *Paramecium* were done and the isoelectric point of the soluble protein fraction, mitochondria and some granules was found to be at a pH value of 4.5. Some particles were neutral in an electric field, but soon after the addition of a soluble protein fraction they acquired the charge properties of the soluble protein fraction. It is clear that soluble protein fractions form surface films around particles and contribute their charge properties to the particles. The charge properties of the soluble protein fraction were identical with the charge properties of the mitochondria and some particles. As the soluble proteins form the basis for the charge properties of cell components, the cell constituents can bear a net positive sign of charge if the intracellular pH is 4.5 or below. A similar situation was observed in experiments on marine invertebrate eggs. Possibly these eggs also have an intracellular pH of 4.5 or below.

The homogenate proteins were titrated and were found to have good buffering capacity on the acid side of the isoelectric point. They can buffer against the metabolic acids produced inside the cells and maintain perfect stability.

Investigations on these cells suggest an intracellular pH of 4.5 or below. If this is found to be a universal phenomena, the physiological pH of 7.0 usually employed in investigations on isolated cells may prove to be quite unphysiological and a much greater concentration of hydrogen ions may be required.

Microfilm \$2.50; Xerox \$4.40. 83 pages.

#### GENETIC STUDIES ON SYNGEN 7 OF *PARAMECIUM AURELIA*. PART I: THE GENETICS OF MATING TYPE DETERMINATION IN SYNGEN 7 OF *PARAMECIUM AURELIA*. PART II: A UNIQUE BREEDING SYSTEM PROPOSED FOR SYNGEN 7 OF *PARAMECIUM AURELIA*.

(L. C. Card No. Mic 60-2851)

Stephan Robert Taub, Ph.D.  
Indiana University, 1960

1. In the two-type stocks 227 and 253 of syngen 7 of *Paramecium aurelia*, a high correlation in mating type occurs between sister caryonides and between cytoplasmic parent

and progeny. This suggests that syngen 7 is a member of the group B syngens in which, as shown by Sonneborn (1954): (1) mating type is controlled by the macronucleus, (2) mating type differentiation of macronuclear anlagen is directed by cytoplasmic factors transmitted by the previous sexual generation, and (3) these cytoplasmic factors are determined as to their effect on early macronuclear differentiation by the macronucleus in cells of one sexual generation in such a way as to maintain the same mating type in the next sexual generation.

2. Two-type stocks are homozygous for a gene,  $mt^{XIII,XIV}$ , which permits the expression of either mating type XIII or XIV. The one-type stock 38 (possibly also stock 228) is homozygous for its allele,  $mt^{XIII}$ , which has a recessive effect on mating type potentialities, restricting homozygotes to type XIII.

3. Except when homozygous  $mt^{XIII}$ , progeny of cytoplasmic parents which carry  $mt^{XIII}$  become completely or predominantly type XIV regardless of the mating type of these parents. Therefore, the  $mt^{XIII}$  gene (or one closely linked to it) has a dominant effect resulting in the production of type XIV-determining cytoplasm by any macronuclei which bear this gene, regardless of the mating type which they control.

4. In syngen 7, selfing caryonides and their individual selfing discard cultures frequently undergo systematic changes in mating type composition during vegetative reproduction and during increasing inanition, respectively. These changes usually involve some part of the sequence: XIII → Selfer → XIV. Selfing caryonides which show any changes and which are derived from cytoplasmic parents which carry type XIII-determining cytoplasm tend to undergo the first part of this sequence, viz., XIII → Selfer. Selfing caryonides which show any changes and which are derived from cytoplasmic parents which carry type XIV-determining cytoplasm tend to undergo the latter part of this sequence, viz., Selfer → XIV. Selfing caryonides of the latter class are more likely to show this change in mating type composition (Selfer → XIV) if they are heterozygous than if they are homozygous  $mt^{XIII,XIV}$ .

5. The following hypotheses are suggested by the above conclusions considered in conjunction with results of others obtained from other syngens of *P. aurelia* and from *Tetrahymena pyriformis*: (1) The cytoplasm in cells of group A syngens, like in those of group B syngens, contains mating type-determining factors. These factors do not direct mating type differentiation in group A syngens because, in these syngens, macronuclear anlagen are not competent to respond to them. (2) The normal allele of the  $mt$  locus (e.g.,  $mt^{XIII,XIV}$  in syngen 7) is involved not only in the production of the even mating type substance, as postulated by Butzel (1953), but also in the production of the mating type-determining factors which occur in the cytoplasm. (3) One of the two mating type-determining states of the cytoplasm which occur in any syngen is characterized by the presence of factors which affect mating type differentiation of the macronucleus. The other cytoplasmic state is characterized by the absence of these factors. (4) In syngen 7, the initial difference between selfing caryonides derived from cytoplasmic parents whose cytoplasms differ with regard to mating type-determining state are due to initial differences in the proportions of macronuclear subnuclei controlling the two different (complementary) mating types; the macro-

nuclei in cells of selfing caryonides initially carry higher proportions of subnuclei which control type XIV if the cytoplasmic parent transmitted type XIV-determining cytoplasm than if it transmitted type XIII-determining cytoplasm. (5) Changes in the mating type composition of selfing caryonides, generally tending towards an increase in the proportion of the type XIV component, are due to corresponding changes in the subnuclear composition of the macronucleus in the cells of such caryonides. These changes are due to the effect of type XIV-determining cytoplasm on subnuclei originally controlling type XIII. In selfers homozygous for  $mt^{XIII,XIV}$ , type XIV-determining cytoplasm would be produced by any subnuclei which already control type XIV. In heterozygous selfers, such a cytoplasmic state would result from the activity of all subnuclei. Thus, selfing may, in part, reflect instability in the subnuclei of the macronucleus.

6. A breeding system consisting mainly of two genically diverse types is postulated. The majority of animals of type XIV would be heterozygous while most animals of type XIII would be homozygous  $mt^{XIII}$ . Such a breeding system differs from those likely in other syngens of *P. aurelia* in two important respects: (1) The resulting synclonal uniformity for mating type would encourage outbreeding to the extent that matings would ordinarily occur between cells from different syncloes; and (2) This system resembles those of genetic sex determination which occur in many higher organisms. A preliminary mathematical model of this system was derived.

Microfilm \$2.50; Xerox \$4.20. 79 pages.

#### A CONTRIBUTION TO THE MORPHOLOGY AND THE CLASSIFICATION OF THE FISHES OF THE FAMILY CHARACIDAE

(L. C. Card No. Mic 60-3842)

Stanley Howard Weitzman, Ph.D.  
Stanford University, 1960

The African and Neotropical fresh-water fish family Characidae is morphologically one of the most diverse groups of living vertebrates. Most members of this family are known only from their external morphology and the basis for their classification is superficial. Several previous investigators have disagreed on many of the major points of characid classification. The present study provides an anatomical foundation for a more adequate classification by describing in detail the osteology of a form chosen for its apparently generalized nature. This work also includes an example of a classification of a small group of characids using that foundation as a basis.

The first of the three parts of this study is devoted to a comparative osteological survey of over 120 species and genera of characids and other fishes. The results of this survey indicate that the Characinae is morphologically the most conservative subfamily of Recent characids. The osteology of *Brycon meeki*, a member of this subfamily, is described and illustrated in detail. This section is



followed by a definition of the family Characidae and of the subfamily Characinae.

The second part of this study comprises a classification of the characid subfamily Lebiasininae based in part on a comparative osteological study of its members and in part on comparisons with the osteology of the Characinae and related characid subfamilies. The Lebiasininae were found to consist of two tribes, the Lebiasinini and Pyrrhulinini. The Pyrrhulinini contain two subtribes, the Pyrrhulinina and the Nannostomina. The assumption by several past authors that the members of the subfamily Lebiasininae are closely related to those of the subfamily Erythrininae was found to be untrue. The Lebiasininae are more closely related to the Characinae. The various family group categories of the Lebiasininae are diagnosed and defined. The osteology of several members of this group is described and the osteology of one species, *Poecilobrycon harrisoni*, is illustrated.

The third part consists of a systematic review of the genera and species of the South American subtribe Nannostomina. This group was found to contain two genera, *Nannostomus* and *Poecilobrycon*. These are diagnosed and defined. *Nannostomus* was found to have five member species. These are illustrated, diagnosed, and described. In addition, three other species of *Nannostomus* known to me only from the literature are admitted. It was not possible to illustrate or describe these three species adequately. *Poecilobrycon* was found to contain three member species; these are illustrated, diagnosed, and described.

Microfilm \$5.25; Xerox \$18.45. 410 pages.

#### THE ROLE OF THE OVARIAN STEROIDS AND RELAXIN IN THE MAINTENANCE OF GESTATION AND DILATION OF THE UTERINE CERVIX

(L. C. Card No. Mic 60-4227)

Jerome Yochim, Ph.D.  
Purdue University, 1960

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The effect of relaxin on the maintenance of gestation and dilation of the uterine cervix was studied in the rat. Rats, ovariectomized on day 12 of gestation, were injected twice daily with various doses of estradiol and progesterone through day 19 of pregnancy. All animals were killed on day 20, twelve to sixteen hours after the last injection of the steroid hormones. The maintenance of gestation

was determined as per cent fetal survival (no. of live, normal fetuses x 100 divided by the no. of sites of implantation). Fetal survival in intact, pregnant rats killed on day 20 of gestation was 93 per cent. As can be seen from Table 1, optimum maintenance of gestation of 90% survival or greater was not achieved after treatment with progesterone alone.

TABLE 1

The Maintenance of Gestation in the Rat  
with the Ovarian Steroids

mg. Progesterone	0.5	1.0	1.5	2.0	2.5	3.0
μg. Estradiol						
0.0		2.6%	49.5%	74.1%	45.5%	61.7%
0.02						73.0%
0.04		55.7%		95.2%		
0.10		69.6%	90.2%	90.0%		70.6%
0.20	61.3%	96.6%		90.0%		90.3%
0.40	42.0%	58.0%		82.5%		92.2%

The addition of estradiol to the progesterone treatment resulted in optimum maintenance of gestation in a wide but measureable range of ratios and within a limited range of absolute dose levels. The injection of relaxin in a beeswax-oil suspension to animals maintained with various combinations of the steroid hormones inhibited the maintenance of gestation at high optimum ratios of estrogen:progesterone, but had no effect at low estrogen:progesterone ratios. Relaxin had no effect on the maintenance of gestation with progesterone alone.

An *in vitro* method was employed to measure mechanically, the dilatability and tensile strength of the cervix during the estrous cycle, gestation and the puerperium. Dilatability, per cent water and cervical weight increased throughout gestation to a peak at parturition. Tensile strength and per cent collagen (as measured by hydroxyproline) of the cervix decreased throughout gestation. Within 48 hours post-partum, all measurements tended to return to non-pregnant values. The peak in dilatability observed at parturition was found to be due in part to stretching induced by the fetus traversing the birth canal. Relaxin caused similar changes in ovariectomized, pregnant rats maintained with the steroid hormones and in ovariectomized, non-pregnant rats primed with the steroid hormones, but the magnitude of changes in the latter group was not as great as in the former.

A preliminary study on the effects of relaxin on the termination of gestation indicated that the hormone is capable of causing premature delivery of the fetuses in ovariectomized, pregnant rats maintained with estradiol and progesterone. Microfilm \$2.50; Xerox \$6.20. 127 pages.

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